TRAFFIC QUARTERLY

AN INDEPENDENT JOURNAL FOR BETTER TRAFFIC

JANUARY 1955

Continental Highways
Milwaukee's Parking Problem
Psychiatric Clinic for Traffic Court
Driver License Action in New York
Statistics on Truck Ownership and Use
New Crossings for the Hudson River
Successful Turnpike Operation
Merchandising a Bus Service
Approach to O-D Analysis
The Mackinac Bridge
Inadequate Laws

THE ENO FOUNDATION FOR HIGHWAY TRAFFIC CONTROL

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VOLUME IX, NUMBER 1 JANUARY, 1955

PRINTED BY COLUMBIA UNIVERSITY PRESS, NEW YORK, N. Y.

Traffic Quarterly

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Published quarterly by the Eno Foundation at Saugatuck, Conn., issue for January, 1955. Printed in U.S.A. Library of Congress catalog card: 50–1781.

A Continental Highway System

SINCE the President recently indicated his special interest in our national highway system, the public, long aware of highway needs, has become aroused.

If appropriately conceived as an axis system interconnecting the vast regions of the country, a national highway system will afford a means of increasing and cementing our national unity. Increased travel will encourage greater appreciation, closer associations and better understanding of the people and products in these areas.

Already there have arisen two schools of thought, basically different in origin and purpose, and totally divergent in approach.

There is no doubt of our urgent need for additional highways and the improvement of much of our existing system. Both needs are of such long standing that continued neglect can only add to the gravity of the problem.

Our past road programs have lagged far behind in planning and providing a core of our basic highway requirements. There has been some extenuation for this and some misguidance.

Many road needs are germane to our economic progress in related fields. Nothing is in sight that threatens to replace our convenient mode of door-to-door highway travel. It is essential. Some of the obvious advantages have become intrinsic in our daily lives.

A national undertaking of sufficient extent to provide an appreciable part of our needs will require a large outlay of federal funds. The source of such funds poses one problem. Their greatest profitable use presents another.

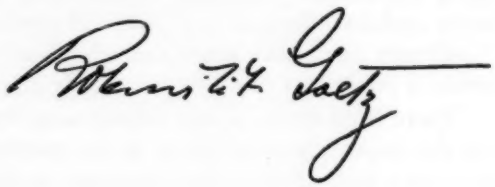
Federal spending of such proportion could readily invite a clamor for participation in widespread expenditures for projects of little direct relation to a national system or realization of the purpose of such funds. Under such conditions it could result in the impossible problem of efficiently integrating local projects based on local conceptions and interests.

Some retrospection on the early expansion of our country, transportation and the prominent part of railroad building should provide a guide to reasonable plans. A survey of the growth of auto-

motive transportation offers reliable assurance of its continued expansion and important contribution to our national economy.

Every premise for the distribution and use of available funds should be based strictly on the merits of its real contribution toward a realization of a national highway system. From the outset, the purpose of the funds ought to be definitely and unalterably determined on its potential economic value to the country.

This determination must be zealously guarded. To this end local interests should marshal their support.



Reasons for the Financial Success of the Pennsylvania Turnpike

CHARLES E. LANDON

Since 1926 Dr. Landon has been a member of the Department of Economics at Duke University except for a period in 1943 and 1944 when he worked in Washington for the Board of Investigation and Research: Transportation Act of 1940. While with this Board he investigated the relationships between transportation and the location of industry. Dr. Landon previously taught economics at the University of Illinois from 1921 to 1926.

THE Pennsylvania Turnpike has been in operation long enough for an analysis of its traffic, revenues, and expenses to indicate what general results can be expected from this type of facility. One should be aware that patterns indicated by this toll-road will not necessarily be repeated in others.

Each toll-road in operation, built for a special situation, is in that respect unique. There are similarities in the traffic and operating conditions among the different turnpikes, but important differences affect the financial results.

The following four tables summarize the income, operating cost, and other expense for the Pennsylvania Turnpike from its opening to the end of the last fiscal year for which figures have been published.

To avoid repeating certain footnotes for each of the tables, certain explanations are made at this point. The year in each case is the fiscal year, which ends on May 31. The original section of the Turnpike was opened on October 1, 1940; consequently the figures for 1941 do not cover a full twelve months. The Philadelphia Extension was opened on November 20, 1950 and the Western Extension was opened on December 26, 1951. The figures on each extension are included from the time it was opened.

Sources of the data are the reports of the Pennsylvania Turnpike Commission. Most of the same data are also published in Moody's, "Governments and Municipals." The volumes for 1951, p. 1090; 1952, p. 1133; and 1954, p. 1137 are particularly useful.

Table 1 shows the relative importance, annually, of the different classes of vehicle using the Turnpike and the proportion of the total toll revenues contributed by each class. The toll schedules occupy so much space that they cannot be presented here. The Turnpike, however, is 327 miles long from the Ohio border to King of Prussia near Philadelphia, and the charge for a passenger car traveling the entire distance is $3.25. A passenger car with trailer pays $5.25. For trucks, the rate ranges from $3.25 to $20.50, depending upon the weight. Buses with a capacity of twelve passengers or less pay $6.25 and those with a capacity of thirteen passengers or more pay $12.25. Motorcycles pay $2.20, and there is a separate classification for special vehicles, for which the charge is $9.

Traffic and Revenue by Class of Vehicle

For a passenger car and the lightest class of truck these tolls amount to a charge of .99 of a cent per vehicle-mile, and to a charge of 1.92 cents per vehicle-mile for the smaller class of bus. These charges are lower than on any other toll-road now in operation or on any toll-road proposed or under construction.

For the largest class of truck and the larger of the two classes of bus, the charges per vehicle-mile amount to 6.31 cents and 3.75 cents, respectively. For the heaviest class of truck, only the vehicle-mile charges proposed for the Indiana, Ohio, and West Virginia Turnpikes are higher than those of the Pennsylvania Turnpike, and for the larger class of bus only the Denver-Boulder, New Hampshire, New Jersey, and Oklahoma Turnpike have lower charges than does the Pennsylvania Turnpike.

Ignoring the early years and the World War II years, Table 1 shows that passenger cars averaged almost four-fifths and trucks roughly one-fifth of the total number of vehicles using the toll-road. When the facility was first opened, and again in 1952 and 1953 after the two extensions were opened, the proportion of passenger cars was relatively high. This condition probably indicates that passenger cars will patronize a new facility of this sort more readily than will commercial vehicles. Commercial vehicles require time to determine whether the toll facility is less expensive in their operations than are others they use. Also, a toll facility may develop new traffic, but time is required to do so.

In addition, many trucking firms would have to obtain the permission of regulatory authorities to change their routes. Because the Turnpike does not enter towns and cities along the route, it is unimportant for bus travel. Only those buses traveling between important terminals without having to load and unload along the route might find the Turnpike advantageous.

TABLE 1

Distribution of Traffic and of Toll Revenues on the Pennsylvania Turnpike According to Class of Vehicle.

	Vehicles Per cent of total				Toll Revenues Per cent of total			
Year	Total (000's)	Passenger cars	Trucks	Buses	Total (000's of dollars)	Passenger cars	Trucks	Buses
1941	1,274	87.5	11.8	0.7	1,418	60.2	38.4	1.4
1942	2,354	86.2	12.7	1.1	2,875	57.4	40.1	2.5
1943	1,120	70.1	28.7	1.2	1,879	28.0	69.8	2.2
1944	954	67.1	31.9	1.0	1,708	25.7	72.3	2.0
1945	1,051	68.4	30.3	1.3	1,819	26.8	71.1	2.1
1946	1,891	80.6	18.1	1.3	2,689	46.1	50.9	3.0
1947	2,577	80.1	18.7	1.2	3,801	44.8	52.8	2.4
1948	3,143	79.1	19.9	1.0	4,844	42.0	55.9	2.1
1949	3,597	77.3	21.5	1.2	5,957	38.5	59.5	2.0
1950	3,962	76.0	23.1	0.9	7,173	35.6	62.9	1.5
1951	5,495	76.1	23.2	0.7	10,127	37.0	61.7	1.3
1952	8,792	81.0	18.4	0.6	15,162	44.4	54.4	1.2
1953	11,304	80.5	18.9	0.6	19,976	43.3	55.6	1.1

In regard to toll revenue, Table 1 shows that during and since World War II trucks have contributed more than half of the total amount. Relative to the number using the Turnpike, trucks contribute revenue at a ratio of somewhat less than 3 to 1. Similarly, buses have a ratio of about 2 to 1.

Sources of Operating Revenues

During the first eleven years of operation, 50.7 percent of the vehicles using the Turnpike were eastbound, and 49.3 percent were westbound. During the same period, 24.2 percent of the passenger cars, more than 48 percent of the trucks, and 30.5 percent of the buses traveled the full length of the highway.[1]

[1] Thos. J. Evans, Chairman, Pennsylvania Turnpike Commission, "Turnpike is Big Business," *Highway Builder*, Nov. 1951, p. 17, Official Organ Associated Pennsylvania Constructors, Harrisburg, Pa.

Table 2 indicates the relative importance of the different sources of operating revenues. As is to be expected, tolls contribute almost the entire amount, and the proportion is pretty uniform from year to year.

TABLE 2

Relative Importance of the Different Sources of Operating Revenues.

Total in thousands of dollars

Year	Total operating revenues	Toll revenues	Per cent of total Concessions	Miscellaneous revenues
1941	1,529	92.7	7.3	a
1942	3,091	93.0	7.0	a
1943	1,969	95.1	4.2	0.7
1944	1,785	95.6	4.0	0.4
1945	1,906	95.4	4.2	0.4
1946	2,905	92.6	7.2	0.2
1947	4,120	92.3	7.4	0.3
1948	5,187	93.4	6.3	0.3
1949	6,325	94.2	5.7	0.1
1950	7,550	95.0	4.9	0.1
1951	10,690	94.7	5.2	0.1
1952	16,185	93.7	6.2	0.1
1953	21,261	93.9	6.0	0.1

a. Included with concessions

Income from "Concessions" refers to rentals from leases and concessions granted to the 22 service stations and restaurants along the Turnpike. At the Midway Station near the Bedford Interchange, there are special accommodations for truckers, among which are sleeping facilities, a smoking lounge, and a recreation room. "Miscellaneous revenue" is from several sources. The Report of the Turnpike Commission for 1952 gives the sources as "Revenue from Special Permits and Permit Haulage Cards" and "Revenue from Sale of Photostats, Waste Paper, etc."

Classes of Operating Expenses

Table 3 shows the relative distribution of total operating expenses among the different items of operating expense.

TABLE 3

Relative Importance of the Different Classes of Operating Expenses.

(total in thousands of dollars)

Year	Total operating expenses	Per cent of total: Maintenance roadway and structures	Maintenance and operation of tunnels	Toll collections	Turnpike patrol	Stores and suspense cost items	General and administrative
1941	651	a	a	a	a	a	a
1942	839	a	a	a	a	a	a
1943	814b	35.7	20.9	13.7	8.9		20.8
1944	781c	35.7	21.4	13.8	8.4	0.5	20.0
1945	745d	38.9	19.3	15.4	5.4	0.5	20.5
1946	779	38.3	19.0	16.8	5.6	1.2	19.1
1947	999	39.0	17.5	17.1	7.9	1.1	17.4
1948	1,186	37.1	20.4	16.4	7.2	0.8	18.1
1949	1,334	36.5	19.1	16.8	7.4	1.1	19.1
1950	1,315	33.5	20.4	18.3	8.0	0.9	18.9
1951	1,913	39.1	15.5	20.9	7.3	1.0	16.2
1952	3,311	42.5	9.5	23.0	7.2	0.7	17.1
1953	4,364	41.5	7.3	17.5	5.4	0.5	19.8

a. Data not available.

b. The sum on which the percentages are based was $819,515, but there was a credit of $5,113 for insurance recovered on damaged property which reduced the net expenses to $814,000 in round numbers.

c. The sum on which the percentages are based was $789,372, but there was a credit of $8,858 for insurance recovered on damaged property which reduced the net expenses to $781,000 in round numbers.

d. The sum on which the percentages are based was $750,072, but there was credit of $5,136 for insurance recovered on damaged property which reduced the net expenses to $745,000 in round numbers.

Understandably, the maintenance of roadway and structures is by far the most important item of operating expense. The relative importance of the expense of maintaining and operating tunnels has declined recently, owing to the fact that all of the tunnels (seven in number) are on the original section. With the opening of the Philadelphia and the Western extensions the toll expense became thus a portion of a much larger total expense.

From the end of the war until the new extensions were opened, the proportion of expense for collecting tolls was fairly uniform. The increases in 1951 and 1952 may be due to the fact that time was re-

quired to integrate this activity for the new sections into the entire system. The cost of collecting tolls is substantial, absorbing roughly the same amount of revenue as do general and administrative expenses.

During the period, 1948–1951, the proportion that toll-collection expense comprised of total operating expenses on the Maine Turnpike ranged from forty-one percent to forty-five percent. A similar figure for the New Hampshire Turnpike in 1951 was thirty-two percent, and for the New Jersey Turnpike in 1953 the expense for collecting tolls was twenty-five percent of total operating expense. The high figure for the Maine and New Hampshire toll-roads comes because of the small number of trucks using those roads and the relatively low rates for the trucks that do use them. The rates for heavy trucks are also much lower on the New Jersey than on the Pennsylvania Turnpike. Toll-roads patronized by a proportionately large number of trucks on which the toll charge is relatively high have an advantage in this respect because it does not cost proportionately more, and possibly no more at all, to collect the toll from a vehicle on which the charge is high than from one on which it is low.

Of late, the expense for patrolling the Turnpike has been roughly one-third as much as the expense for collecting tolls. For a few years before 1951, patrol expense had been about 40 percent as much as that for collecting tolls. The recent decline in proportion to total expenses may be because it is unnecessary to increase expenses for patrolling directly with increases in traffic. Within limits, the expense for patrolling may be a constant cost.

A comparison of the Pennsylvania Turnpike with other toll-roads shows that the expense for patrolling is a much smaller proportion of total operating expense on the former than on the others. Patrol expenses were seventeen percent of the total operating expenses on the New Jersey Turnpike in 1953, sixteen percent for the first year of operation on the Turner Turnpike in Oklahoma, and thirty-three percent on the New Hampshire Turnpike for the fiscal year ending June 30, 1951.[8]

[8] In New Hampshire the toll-road is administered by the State Highway Department, and in its reports patrol expense is included as a maintenance expense, with an almost equal division of the amount between the Highway Division and the State Police Department. The above figure was derived by adding the amount for patrol expense to other operating expenses and then dividing the total into the patrol expense.

The Marine Turnpike Authority spends only a small amount of turnpike revenue for patrolling because the law authorizing the construction and operation of the toll-facility permits the Authority to use the state highway police for this purpose.

Adequate patrol facilities and personnel are important factors in toll-road operations because of the connection between this activity and the number of accidents. A high accident rate may discourage motorists from using a toll-facility. It may also increase the operating costs of motor vehicles because of increases in insurance rates on vehicles using the toll road, hence reducing the importance of a major reason for the use of toll-roads by commercial vehicles.

A final expense item, stores and suspense cost items absorb a small amount of revenue. In the Report of the Turnpike Commission for 1952, the preceding category is given as "Stores and Reimbursable Property Damage."

Table 4 presents a summary of income and its distribution to operating expenses and other classes of deductions. "Total income" is determined by adding "other income" to "net operating income" (operating revenues minus operating expenses). According to the Report of the Turnpike Commission for 1952, "Other income" consisted of interest on insurance fund investments. The total income column shows the amount remaining for meeting bond interest and principal and other deductions from income that the Turnpike's methods of accounting require. Appropriations to the "replacement reserve fund" are for the purpose of establishing a fund that may be drawn upon to replace the turnpike and its equipment. The insurance fund is to pay the premiums on any insurance carried and to repair, replace, or reconstruct any part of the Turnpike that may be damaged or destroyed. On the present Turnpike, the insurance fund must be maintained at an amount of at least $500,000.

Beginning in 1952, when serial bonds started to mature, the sum required for interest and principal was about $6.5 million. The following year the amount rose to almost $9.4 million, and it does not exceed $9.9 million in any year during the life of the bonds outstanding on the present Turnpike. The final maturity of these bonds will come in 1988. From 1969 to 1988, the annual sum required for interest and principal will be slightly more than $9.5 million. By comparing the sum required for the payment of interest and principal

TABLE 4

Summary of Income, Expense, and Other Deductions.

(in thousands of dollars)

Year	Total operating revenues	Operating expenses	Net operating income	Other income	Total income	Bond interest	Replacement reserve fund appropriation	Insurance fund	Net income
1941	1,529	651	878	—	878	—	—	–	878
1942	3,091	839	2,252	—	2,252	1,020	—	–	1,232
1943	1,969	814	1,155	5	1,160	1,530	12	a	(d) 382
1944	1,785	781	1,004	5	1,009	1,554	5	a	(d) 548
1945	1,906	745	1,161	3	1,164	1,586	9	a	(d) 431
1946	2,905	779	2,126	—	2,126	1,586	—	–	540
1947	4,120	999	3,121	5	3,126	1,250	2	a	1,874
1948	5,187	1,186	4,001	30	4,031	1,144	46	6	2,839
1949	6,325	1,334	4,991	5	4,996	834	218	1	3,943
1950	7,550	1,315	6,235	5	6,240	1,058	187	2	4,993
1951	10,690	1,913	8,777	4	8,781	2,236	157	b	6,388
1952	16,185	3,311	12,874	5	12,879	4,778	1,257	b	6,844
1953	21,261	4,364	16,897	8	16,905	5,891	3,383	b	7,631

a. Included with Replacement Reserve Fund Appropriation.
b. Negligible amounts.

with the column for "total income" in Table 4, the income of the Turnpike is more than sufficient to pay off the bonds as they mature. If the operating revenues are maintained at the present level, the Turnpike should have no difficulty in meeting its bond obligations. Recently, according to a publication of the Pennsylvania Turnpike Commission, bond retirements were fifteen years ahead of schedule.[8] Reasons for this financial success are discussed in the remainder of this paper. It may be stated here that most of these reasons apply to all the different toll roads now in operation.

Factors in the Financial Success

Several factors have contributed to the financial success of the Pennsylvania Turnpike. First, relatively low toll-charges on the lighter types of vehicles have attracted patronage. These charges were given earlier in this paper. Low construction costs for the original section of 160 miles helped to make these low toll-charges possible. This section was built before World War II began and with the aid of a federal subsidy of $29,250,000 granted by the Federal Public Works Administration to help combat unemployment. The Turnpike Commission also purchased for $2 million the route of an abandoned railroad on which $10 million had been spent in boring tunnels and making open-cut excavations. Low construction costs are offset to some extent by the high original financing charges resulting from the untried nature of the project. The original issue of bonds bore an interest rate of three and three-quarters percent. These bonds were later refunded, however, at a lower rate of interest.

Another important factor in the success of the original section is the unfavorable terrain on the parallel free roads. These roads have maximum ascending grades of nine to nine and a half percent compared with a maximum of three percent on the Turnpike. A trip over the alternate routes involves a total vertical climb of more than 13,000 feet, but the Turnpike, because of a careful selection of route and of the use of tunnels, has a total vertical climb of only 3,940 feet. In addition to heavy grades, one of the alternate free roads, the William Penn Highway, follows a winding course over a

[8] Wm. A. White, "One Road Leads to Another." This article by Mr. White appeared in the *Pittsburgh Press* of Nov. 15, 1953, and it was printed by permission of the Turnpike Commission.

portion of its route and hence has many curves with low radii. On the Turnpike each curve permits a minimum sight distance of 1000 feet.[4]

These features of the Turnpike reduce driving time, fuel consumption, and the danger of skidding on icy grades in winter, advantages which have been particularly attractive to truck operators. The effects of this modern thoroughfare on gasoline consumption and speed in trucking operations are shown in a comprehensive study of the Highway Research Board on the Pennsylvania Turnpike. Certain results of this study are summarized in the following paragraph.

In 1948, comparative tests for gasoline consumption and for speed were conducted on the Pennsylvania Turnpike between Carlisle and New Stanton interchange, a distance of 148.7 miles, and on a parallel route consisting of U. S. 11 from Carlisle to Chambersburg and U. S. 30 from Chambersburg to Greenburg, near New Stanton interchange, a distance of 149.4 miles. Although covering approximately the same distance as the Turnpike, the free road had much variety in surface type, width of pavement, gradient, and curvature. Tests were made both eastbound and westbound with seven different classes of trucks and three different gross weights in each class. The speed limit was the legal one in each case, fifty miles an hour on the Turnpike and thirty miles an hour on the free road. A representative selection of eleven vehicles from this study, ranging from 20,030 pounds to 139,500 pounds in gross weight, reveals that average gasoline consumption was 3.77 miles per gallon on the Turnpike and 2.35 miles a gallon on the free road and that average speed was 38.9 miles per hour on the Turnpike and 21.2 miles per hour on the free road. The average gasoline consumption on the free road was sixty-one percent greater per mile than on the Turnpike and the average speed per hour was eighty-three percent higher on the Turnpike.[5]

Finally, the major factor in the success of the Turnpike is the preference of a large number of motorists for it over the alternate free roads. The reasons for this preference will now be discussed.

[4] *See An Informational Summary of the Pennsylvania Turnpike,* Pennsylvania Turnpike Commission, Nov. 12, 1948, p. 9. Mimeographed. *Report of 1952,* Pennsylvania Turnpike Commission, p. 17.

[5] For the details of this survey see, *Time and Gasoline Consumption in Motor Truck Operation,* Research Report No. 9—A, Highway Research Board, Washington, D. C., 1950.

The motoring public is enthusiastic about the Pennsylvania Turnpike either because of the high quality of transportation service or because of reductions in vehicle operating costs, or both. Although both reasons apply to the different classes of motor vehicles, the former one is more important to the drivers of passenger automobiles and the latter to the operators of commercial vehicles. The fact that motorists willingly pay a toll that is equivalent to a gasoline tax of twelve to fifteen cents or more a gallon, depending upon the mileage obtained per gallon, indicates a recognition of the advantages of the most modern types of highway design. Evidently, motorists want good roads and they are willing to pay for them now in order to have them.

In every state with a toll-road the motorist, in addition to paying the toll for using the turnpike, also pays the state gasoline tax on gasoline purchased in the state. None of the state toll-road laws provides for refunds of the tax on gasoline consumed by travel on the toll-roads. The tax collected is spent on the free road systems of these states.

As far as the drivers of passenger cars are immediately concerned, the toll-road provides them with service that is superior in speed, safety, and convenience, compared with existing alternate routes. But in addition to these advantages it has also been demonstrated that such roads reduce the operating costs of passenger automobiles. The saving in gasoline is obvious to the driver but some of the other economies are not so obvious except with the passage of time. Garage mechanics along the Pennsylvania Turnpike report less wear and tear on vehicles than on parallel roads. Brakes are used less, fewer tires blow out owing to easy curves, motors do not heat, and oil consumption is low.[8]

There are highway engineers who believe that roads with the design standards of our toll-roads may reduce the cost of operating a passenger automobile by more than the amount of the toll. According to studies that have been made only from seven to ten or eleven percent of the average cost for operating a passenger automobile over the prevailing type of improved highway goes toward providing

[8]See Marshall Sprague, "A Motorist's Report on the Pennsylvania Turnpike," *New York Times*, July 29, 1951, Sec. 2, p. 13x.

the road, the remainder going for the car itself.[7] Motorists who use toll-roads, in addition to saving time, having a more pleasant trip, and saving fuel and oil with less wear on the car, may reduce the cost of operating the car, including the toll, to less than what the cost would be on the alternate roads. By paying more for the road, the operating cost of the car may be lower by more than enough to provide the road. Obviously, there is a net economic gain.

Commercial vehicles use toll roads because the reductions in operating costs amount to more than the toll charge. The superior service and other factors mentioned in the previous paragraph may contribute to such reductions. Savings in gasoline and time are illustrated by the comparative tests on the Pennsylvania Turnpike and parallel roads that were discussed earlier. In addition to saving gas and time, the limited-access feature of toll-roads is important in these respects, making high average speeds without frequent starts and stops possible. One truck operator said it cost his company seven cents for every stop at a traffic signal.[8] Another operator of a major fleet of trucks said that one stop of a heavily-loaded semi-trailer at a traffic light costs one gallon of gasoline.[9] On the New York Thruway, three hours or more will be saved by trucks traveling between New York and Buffalo in spite of the fact that the Thruway is about sixty-eight miles longer than the shortest free route. On the Thruway, trucks can maintain a speed of about fifty miles an hour; on the free road they cannot usually do better than thirty miles per hour.

The Value of Time Saved

An important reason for the use of toll-roads rather than alternate routes is the saving of travel time, owing to more direct routes, better road surface, reductions in gradient, and in the number of grades and curves, and the elimination of intersections, grade crossings, and congestion. Obviously, these factors will also reduce operating costs.

[7] See Harmon E. Davis, "Issues Involved in Toll Road Financing," a discussion presented at the meeting of the Highway Committee, Southern California Council of the California State Chamber of Commerce, Los Angeles, Feb. 14, 1951. Mimeographed. See also, *Highway Needs in Michigan*, An Engineering Analysis by the Highway Study Committee, Michigan Good Roads Federation, 1948, p. 60.

[8] Bert Pierce, "Automobiles: Trucks on the Pike," *New York Times*, Nov. 25, 1951, II, Part 2, 27:1.

[9] T. J. Kauer, Director, Dept. of Highways, State of Ohio, "The Case for the Toll Turnpike," *State Government*, 23:86 (1950).

For the driver of an automobile, in most instances the saving of time is a convenience which cannot be given an exact mathematical valuation, and the subjective valuation varies with the individual and with conditions.

For commercial vehicles, the saving of time reduces operating cost that can be measured statistically. One highway official estimated a toll-route between New York and Chicago would reduce the driving time of a truck one full working shift; hence its wages, could be saved.[20]

According to one authority, estimates of the value of time for the driver of the passenger automobile range from one cent to two cents a minute with two cents a conservative figure under current conditions and for commercial vehicles a value of three cents a minute is reasonable.[21] Another authority says a motorist will not pay in toll all he saves in gasoline, but if he also saves time, or he saves much time and little gasoline, then he may be expected to pay a toll commensurate with such saving. The Oregon Highway Commission has expressed the opinion, however, that except under the most favorable conditions, the financial burden on highway users is not offset by savings in gasoline and time.[22]

Accidents on Toll-Roads

Not all patrons of toll-roads may be interested in saving time. Some may wish to be relieved of the various inconveniences of travel encountered on free roads, among which are traffic congestion, traffic lights, grade crossings, the strain of driving up and down hill and around curves, and the chance of accident. This last point is of such importance that it deserves further attention.

[20] Ibid.

[21] Thos. J. Fratar, Knappen Tippett Abbett Engineering Company, "Some of the Economic Aspects of Highway Planning," *Traffic Quarterly*, 3:325 (1949).

George W. Burpee, "The Problems of Forecasting Traffic and Revenues" in Byron W. Shimp (editor) *Financing Public Improvements*, 1939, p. 49.

For methods used by two highway experts to determine the value of the time saved by better highway facilities see, M. H. West, "Economic Value of Time Savings in Traffic," *Proceedings, Seventeenth Annual Meeting, Institute of Traffic Engineers*, Columbus, Ohio, Oct. 3–5, 1946, pp. 144–148, and J. M. Olayos, "Methods Used by the California Division of Highways for Estimating Induced Traffic," *Proceedings, Twenty-first Annual Meeting, Institute of Traffic Engineers*, New York City, Sept. 24–27, 1950, pp. 52–61.

[22] *Arguments Against and For Toll Roads*, April 1951. A typewritten article supplied to the author by the Oregon Highway Commission.

Toll-roads have not been free of accidents and, owing to the high average speeds maintained and the large size of many of the trucks using these routes, there is the possibility of a relatively high percentage of fatal accidents and of accidents with heavy property damage. The possibility of accident might be such as to discourage the use of a toll road by the operator of the private automobile and the number of accidents might be so high that the resulting insurance rates would reduce use by both the private automobile and the commercial vehicle.

At one time, this problem was of much concern to the Turnpike Commission and comprehensive continuing studies of the causes of accidents were begun. In 1949, the average property damage on the Pennsylvania Turnpike was five times,[33] and in 1950 it was ten times[34] the national average for all other highways. These conditions caused one operator of trucks to remove all his trucks from the Turnpike at the time.[35]

The Turnpike Commission continues to take remedial action to prevent accidents on the basis of the findings of the studies already mentioned. Among the more important causes of accidents are excessive speed, falling asleep, and construction faults. One police official[36] attributed the accident rate to the failure of motorists to comply with regulations and an insufficient police force to enforce them. Falling asleep at the wheel may result from poor sleeping and eating habits or from the hypnotic effect caused by the monotony of the road. The more important construction faults were narrow pavement in some places and the lack of shrubbery between the opposing pavements to reduce headlight glare.[37]

The latest report of the Pennsylvania Turnpike Commission does not have statistics on accidents but the reports of some of the other Turnpike Authorities provide instructive data on this matter. In its first year of operation the Turner Turnpike in Oklahoma had a fatality rate of 4.25 per 100-million vehicle miles.[38] This contrasts

[33] V. T. Boughton, "Are Toll Highways Accident Breeders?" *Engineering News-Record*, Oct. 18, 1951, p. 30.

[34] "Wrecks Cool Enthusiasm for Toll Roads," *Business Week*, April 21, 1951, p. 108.

[35] Ibid., p. 109.

[36] Statement of James Young, Chief of Police, Bedford, Pa. Quoted by Marshall Sprague, op. cit.

[37] "Wrecks Cool Enthusiasm for Toll Roads," op. cit., pp. 110, 112.

[38] *Report of the first Year of Operation of the "Turner Turnpike,"* Oklahoma Turnpike Authority, pp. 72–73.

with a figure of 7.3 for all highways and streets of the nation in 1952, although the two figures are probably not strictly comparable. On this Turnpike the two principal causes of accidents were blowouts and the driver going to sleep. On the New Jersey Turnpike the fatality rate was 4.14 per 100-million vehicle miles in 1953, ranking with three states and the District of Columbia which reported the lowest rate for the nation in 1952. On the two highways which parallel the New Jersey Turnpike, the fatality rate in 1952 was 6 per 100-million vehicle miles. In 1953 total accidents on the Turnpike were at the rate of 67.1 per 100-million vehicle miles and in 1952, at the rate of 92.7. For the latter year, the accident rate on parallel highway No. 130 was 410 per 100-million vehicle miles.[29]

The experience over the country indicates that limited-access divided highways have a much lower accident rate than does the prevailing type of highway. Consequently, toll-roads, since they are located primarily in areas of heavy traffic density, can be expected to reduce the loss of life and property from highway accidents.

Toll-Roads Develop New Traffic

Thus far the discussion may lead the reader to believe that all toll-road traffic is taken from or diverted from parallel free roads. This is not true. The amount of diverted traffic is substantial, though, else toll-roads would not be enjoying the high degree of financial success that they are. Toll-roads, owing to their superiority over the existing alternate roads, also develop new traffic.

The construction of the New Jersey Turnpike is expected to cause an industrial and home building boom in the central and south central sections of the state. The Atlantic City Electric Company, on the basis of a survey it made, estimates that 100 new commercial establishments and 10,000 new homes will be built within its market area.[30] Although such expansion would be competitive with established centers of commerce and industry, it would also develop new traffic and new traffic patterns.

Similar results have been predicted for the West Virginia Turnpike. The firm which made the traffic survey for this project believes that it will be particularly attractive to truck traffic and will there-

[29] *Annual Report 1953*, New Jersey Turnpike Authority, p. 36.
[30] *New York Times*, Oct. 21, 1951, I, 79:1.

fore create a new transportation pattern between the southern Piedmont and the Great Lakes region. Particularly would this be true if Virginia and North Carolina build turnpikes which would extend this toll route into the heart of the southern Piedmont textile, tobacco, and furniture manufacturing areas. Such a route also should attract much traffic from Florida destined for the Midwest.

Because the West Virginia toll-road will eliminate the detour barrier caused by the lack of north-south transportation routes across the state, it is thought that much of the potential traffic will be that now using roundabout routes to Pittsburgh and the lower Lake cities. Such a change in route would save much time for southern shippers of both agricultural and manufactured commodities in reaching these markets. In addition to drawing traffic from roundabout routes, this turnpike should stimulate industrial growth, and hence new traffic, in the region it will serve.

The New York Thruway provides a third example of this sort. Because of the prospect of quicker delivery to market, new factories in many different fields of manufacture are being built along this route. Manufacturers are thus able to obtain the advantages of locations away from the heavily populated centers. The more rapid delivery also permits mercantile establishments to operate with lower inventories, hence reducing the amount of capital required to do a given amount of business. Of course, these new factories increase the competition for those already established, but making greater supplies of goods available from more distant points is a function that improved transportation is supposed to perform for buyers.[21] The Thruway will divert traffic from other roads, but at the same time it will create new traffic and develop new traffic patterns.

But regardless of whether the traffic is diverted or new, the competitive advantages or relative economy and fitness of a toll-road compared with alternate means of transportation provide economic benefits for the area it serves. The exchange of goods is made easier; the trading area of the commercial interests of the community is enlarged, in regard to both buying and selling activities; and there are wider markets for the products of the manufacturing and agricultural enterprises of the region.[22]

[21] A. H. Rashkin, "State Boom Follows the Highway" *New York Times* June 20, 1954, Sec. 10, The New York Thruway, p. xx3, provides many details concerning the developments along the Thruway.

[22] See *Preliminary Report of Special Subcommittee for Study of Highway Finance,*

In any instance in which toll roads make possible the reduction of total costs of production below what they would be by alternate means of transportation income is generated and wealth is created. An excellent illustration of this point is provided by the New York Thruway in Yonkers. The obtaining of the Thruway route there removed $2½ million from the tax lists, but new construction in the area, because it is to be the route for a modern highway, has amounted to about $12 million.[23]

Reasons for the Toll Method

In order not to leave a wrong impression before closing, perhaps it should be emphasized that the different advantages attributed to toll-roads in the preceding pages are really advantages which result from the use of highways built to high standards of design, whether toll-roads or limited-access freeways. But it should also be emphasized that the toll method of financing seems to be the only method by which we can obtain badly needed modern highways immediately.

That being the case, the nation can realize the benefits from good roads more readily through the use of the toll method of finance. Voters do not favor increases in taxes and most state officials consider it to be unwise to present large bond issues to the voters for approval. Some states also have constitutional prohibitions against the issue of general obligation bonds.

To take one example, in New Jersey different methods of finance, including an increase in the gasoline tax, a bond issue, and a combination of the two, were investigated and were found to be politically impracticable.[24] Highway user groups opposed an increase in the gasoline tax, one reason being that highway funds had been used for non-highway purposes, and the same groups opposed a general bond issue serviced in part with gasoline taxes. A proposed issue of revenue bonds to finance a toll-road received widespread support, however.

In regard to obtaining needed highways in New Jersey by the

American Association of State Highway Officials, Committee on Highway Finance, 1949, for a discussion of the advantages of highways of high design standards.

[23] See "Thruway is Tax Raiser," *New York Times*, Aug. 29, I, 61:3.

[24] *The New Jersey Turnpike*, The New Jersey Turnpike Authority, Trenton, 1949. Mimeographed.

usual methods of finance, one highway official said that in view of the state's present needs for new and expanded highway facilities, including maintenance and repair of the existing highway plant, engineers estimated that, under present methods of allocating highway funds, from thirty-five to fifty years would be required to construct the New Jersey Turnpike as a free road.[*] Highway officials in several other states have made similar statements in respect to the problems of highway finance in their respective states.

In view of the appealing argument that highway users pay for the highway and of the fact that motorists apparently are more than willing to pay for the privilege of using toll facilities, in the minds of many people the toll method of finance is therefore an ideal one for providing a greater mileage of expensive highways that either provide a de luxe transportation service for those who are able and willing to pay for it or else reduce the costs of transportation. Expediency, then, is a major argument for the construction of toll-roads.

This seems an opportune point to mention another function which toll-roads can serve. Since those who use them pay for them, toll-roads serve as a yardstick to measure the relative economy and fitness of the different modes of transportation for certain fields of commercial traffic. Agencies that could not compete with the turnpikes would be outmoded for the particular classes of traffic.

Future Toll-Road Mileage

The financial success of existing toll-roads has encouraged many other states to investigate this method for providing improved highways, with the result that several states now have such roads under construction and an even larger number is investigating their economic feasibility. A brake upon unwise expansion of toll-roads is the fact that their construction must meet the approval of investment bankers before they will agree to underwrite the bonds that are usually issued to finance such projects.

The approval of the bankers is based upon engineering and traffic surveys made by firms which specialize in this kind of work.

[*] Paul L. Troast, Chairman, New Jersey Turnpike Authority. Press release of the New Jersey Turnpike Authority, Trenton, Oct. 10, 1949.

In the case of the turnpikes now in operation, however, the preliminary estimates of traffic and revenue were far short of the actual results, and the field in which toll-roads can operate successfully is much wider than these early studies indicated. The conservativeness of the early estimates may be due in part to the lack of experience with toll-roads and in part to the unprecedented period of prosperity prevailing since World War II.

In the future, preliminary estimates of traffic and revenue for proposed toll-roads may be expected to more nearly approach the actual results in the cases in which the surveys establish the economic feasibility of the projects. Because of unexpectedly high revenues on toll-roads in operation, and because the nation will certainly make every effort to maintain a high rate of prosperity, the mileage of projects financially successful is probably greater than so far supposed.

Planning New Vehicular Crossings for the N.Y.-N.J. Metropolitan Area

ROGER H. GILMAN

Mr. Gilman has been Director of Port Development of The Port of New York Authority since December, 1953. Following completion of the course at the Harvard Bureau for Street Traffic Research, he joined the Port Authority in 1937 as a statistician and has been with the bi-state agency since that time. He is a member of the American Society of Civil Engineers and the Institute of Traffic Engineers.

THE Hudson River boundary between New York and New Jersey has always challenged the ingenuity and resourcefulness of those who would reduce the effects of this political and geographical separation between important sections of the great metropolitan area. The challenge has been met by architects of our governmental structure as well as by planners and builders concerned with transporting people and goods.

Highway planning in the New York-New Jersey metropolitan area has been confronted with great transportation and terminal problems resulting from the tremendous growth in motor vehicle ownership and usage during the last thirty years. These problems, similar in all parts of the country, have been accentuated in this area by the world's greatest concentration of population, business and industry. Solution of these problems is even more difficult because at the center of the region is the busiest harbor in the country, with wide waterways and deep channels.

While these waterways—which serve all parts of the area and are so essential to a great port—provide valuable arteries for the movement of water-borne commerce in the harbor, they at the same time require frequent spanning by many costly bridges and tunnels. The problems have been made even more difficult and complex by the great number of separate governmental jurisdictions in this New York-New Jersey metropolitan region. The area includes the most populous parts of two states, twenty-one counties and over 500 municipalities, each with its own powers and responsibilities.

During World War I, increasing transportation problems underscored the need for an agency capable of planning, financing, building and operating great public works on a regional basis. Because of the bi-state nature of the area, such an agency was needed to represent both states in meeting these problems.

Joint Agency Developed Port

Several years of penetrating research and analysis were devoted to these problems by a New York-New Jersey port development commission. As a result of the commission's report and recommendations, the two states signed a Port Treaty of 1921, approved later by the Congress and the President, establishing The Port of New York Authority as their joint agency for promoting and developing the port. The Treaty assigned to this new organization the power and authority to plan, build, lease and operate transportation and terminal facilities within a port district embracing the metropolitan areas of the two states lying generally within a radius of about twenty-five miles of the Statue of Liberty. Under the port treaty, the Port Authority was given the further task of promoting, protecting and improving the commerce of the port. The two states also directed the Port Authority to maintain continuing liaison and to cooperate with other area governmental agencies concerned with highways, channels and other facilities of commerce.

It is interesting that the men who drew up the Port Treaty of 1921 anticipated the great increase in motor vehicle usage and highway construction in the years to follow. The Treaty and the Comprehensive Plan of 1922 therefore directed the Port Authority to cooperate with the highway commissioners of the two states in developing a coordinated highway transportation system for the area which would assure direct connections with all bridges, tunnels and ferries and permit the most efficient inter-relation between terminals, piers, and industrial establishments for the handling of motor truck traffic.

In its thirty-three years of existence as the bi-state agency for the area, the Port Authority has invested more than $500,000,000 in the construction of bridges, tunnels, airports and marine and inland terminals for handling passengers and freight in the New York-New

Jersey port district. Its staff of almost 4,000 employees, under the direction of an unsalaried twelve-man board of commissioners, carry out the provisions of the Port Treaty of 1921 in developing and operating facilities designed for economical and efficient transportation.

Of paramount importance in the Port Authority program is the requirement that its facilities must be self-supporting. The Authority program thus relieves the already sorely pressed taxpayer from paying for these special transportation projects and frees the tax monies of cities, counties and states for general governmental services such as schools, parks, streets and other tax-supported activities.

Interstate Tunnels and Bridges

In the mid-1920's, increasing highway travel showed the growing need for interstate crossings of the Hudson River between northern New Jersey and New York City as well as interstate crossings of the Arthur Kill and Kill van Kull, important waterways lying between Staten Island, one of the boroughs of New York City, and the New Jersey mainland. Such crossings were essential to provide quick and easy highway access between the two states.

In accordance with its responsibilities, a program of interstate bridges and tunnels was undertaken by the Port Authority to meet this need. To date, more than $300,000,000 has been invested by the Port Authority in its six tunnels and bridges. Crossing the Hudson River are the Holland and Lincoln Tunnels and the George Washington Bridge. The Bayonne Bridge, Goethals Bridge and Outerbridge Crossing link Staten Island with the New Jersey mainland.

Important as these bridges and tunnels are in themselves, the Port Authority recognizes that direct connections between these facilities and the arterial highways of the region are essential to provide motorists with the transportation they require. Almost one-half the total cost of these projects is therefore represented by the investment in direct connections to major arterial highways on both sides and in adequate plazas for dispersal of traffic to avoid street bottlenecks. Nearly $150,000,000 has been spent by the Port Authority in building plazas, viaducts, new express streets, depressed roadways, subterranean tunnels and other arterial approach links so that traffic will flow freely and easily to and from these river crossings. In this

FIGURE 1. Three-mile approach roadway from Lincoln Tunnel connects with New Jersey Turnpike and State Highways.

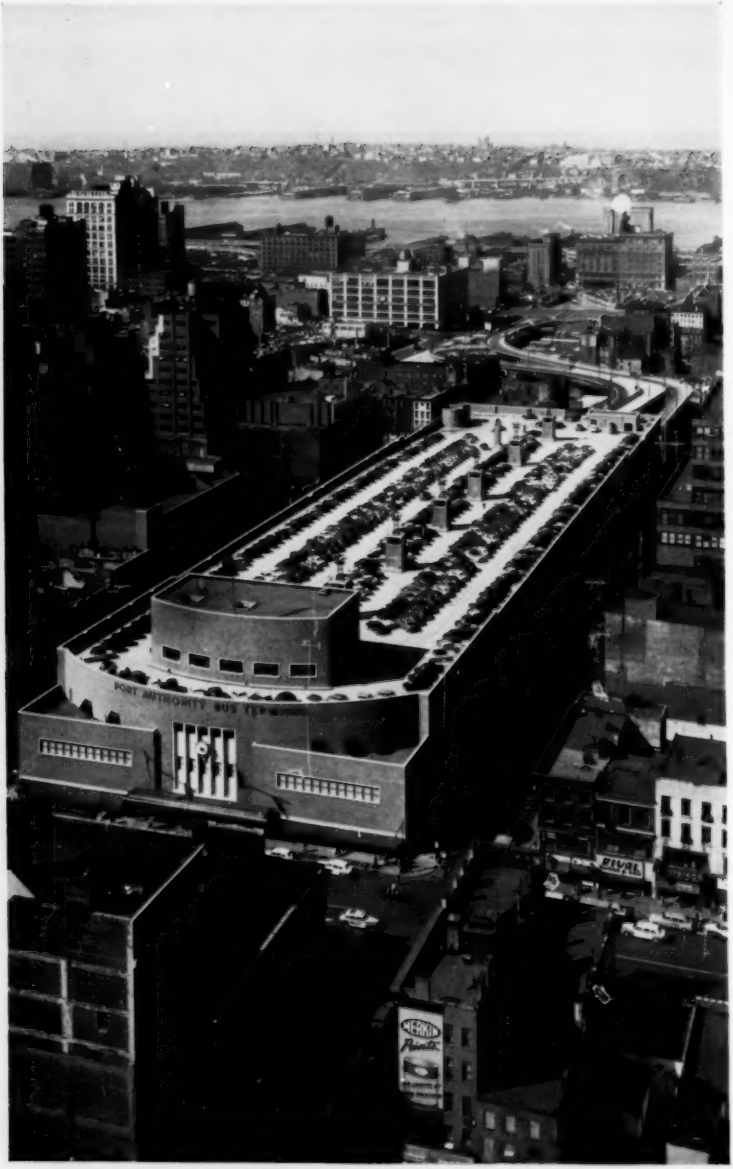


FIGURE 2. Port Authority Bus Terminal handles over 5,000 interstate buses a day as well as 450 cars parked on the Terminal roof.

way, the interstate tunnels and bridges built by the Port Authority serve as special facilities integrated into the overall highway system.

For example, the Lincoln Tunnel connecting midtown Manhattan with New Jersey has elaborate direct connections with main arterial routes in both states. Nearly 85 percent of the Lincoln Tunnel traffic on the New Jersey side is interchanged with the state highway system to the west. A three-mile connection from the Tunnel plaza—including a six-lane open cut through Bergen Hill, an elevated viaduct and connection across the meadows, and an interchange with the New Jersey Turnpike—has been built by the Port Authority at a total cost of $17,000,000 and turned over to New Jersey for operation as part of the state highway system.

On the New York side an oversize plaza, including a new six-lane north-south Dyer Avenue extending from 34th to 42nd Street, was built at the time of the original construction of the Tunnel to disperse traffic to six crosstown streets and three north-south avenues. In connection with the current expansion of the Lincoln Tunnel capacity by two new under-river lanes, the approaches in both New York and New Jersey will be further expanded.

At the George Washington Bridge, similar elaborate interchanges are provided on both sides of the river. On the New Jersey side, the Bridge plaza was extended to connect with the main east-west arterial highways through Bergen and Passaic Counties, N. J. 4 and U. S. 46. The Port Authority completed in 1954 at a cost of almost $5,000,000 a further expansion of the approaches to afford a direct connection between the Bridge and the Palisades Interstate Parkway, now under construction to the north along the Hudson by the New Jersey State Highway Department and New York State Department of Public Works.

On the New York side, the George Washington Bridge has already been connected by two tunnels under Washington Heights to an elaborate interchange with the Harlem River Drive which will eventually be linked to the Major Deegan and Cross Bronx Expressways, still under construction. The first stage of an improved connection between the George Washington Bridge and the Henry Hudson Parkway was completed in 1953; the Port Authority and Triborough Bridge and Tunnel Authority shared the construction cost of this ramp connection.

At the Holland Tunnel a $3,000,000 viaduct in Jersey City was put in service in 1951 to provide an improved connection between the Tunnel and local Jersey City streets with the Pulaski Skyway. Plans have been developed with the City of New York to connect the Holland Tunnel to a lower Manhattan crosstown elevated expressway, whenever the construction of that arterial highway is undertaken by the city.

Consolidated Terminals for Interstate Traffic

Closely allied to the development of bridges, tunnels and their approach connections for the handling of interstate traffic is the Port Authority's construction and operation of consolidated terminals for buses and trucks. In Manhattan, the Port Authority Bus Terminal at 41st Street and 8th Avenue is linked by direct ramps with the Lincoln Tunnel. These overhead ramps permit the suburban commuter buses between New Jersey and midtown Manhattan to enter the terminal without touching Manhattan streets.

The long-haul buses which amount to only 10 percent of the terminal's bus volume now are only required to drive two short blocks on the city's streets to and from the tunnel. Thus since the terminal opening in 1950, the 5,000 interstate buses which enter and leave the Port Authority Bus Terminal each day no longer clog Manhattan streets in the Times Square area. The terminal roof also accommodates the parking of 450 cars which reach the roof from the Lincoln Tunnel by the same overhead ramps used by suburban buses.

Uptown at the George Washington Bridge, the Port Authority is studying, at the request of local Washington Heights merchants, the possibility of a consolidated terminal at the Manhattan plaza for handling interstate buses using the bridge. In 1949, the Port Authority opened its first Union Motor Truck Terminal in lower Manhattan, about four blocks from the Holland Tunnel. This consolidated terminal is leased and used today by eleven over-the-road truck companies which move almost 1,000 tons a day of merchandise-freight across the 800-foot long platform. Small pickup and delivery trucks handle the movement within New York City of the freight transferred across the platform to and from the long-haul

carriers. Thus, the long-distance tractor-trailers of the New York Union Motor Truck Terminal tenants going to the south and west, have only to travel four blocks on the city streets to reach the Holland Tunnel.

In New Jersey, the Port Authority completed in 1950 its Newark Union Motor Truck Terminal, designed to serve the eight counties of northern New Jersey just as the Manhattan terminal serves all of New York City. Despite the fact that the International Brotherhood of Teamsters has stated that any obstacle to the operation of the terminal can only hamper and impede the proper expansion of the trucking industry and in the long run prove a detriment to the truck drivers, a restrictive clause in the local teamsters' union contract prevents use of this terminal by over-the-road truckers. At present, the terminal is therefore leased to the U. S. Air Force. When the Air Force lease terminates, the commissioners of the Port Authority will operate the terminal as a union consolidated trucking facility serving all of northern New Jersey.

As part of the vehicular facilities in this area, these consolidated terminals play an important role in the handling of interstate traffic and significantly relieve arterial traffic congestion.

Post-War Studies of Additional Crossings

Following the end of World War II, the rapid growth of interstate vehicular traffic soon began to tax the capacities of the tunnels and bridge spanning the Hudson River between New Jersey and New York. In 1949, the Port Authority made an extensive origin and destination survey of the traffic crossing the Hudson River. Individuals in a carefully selected sample of 135,000 motorists were interviewed at the Holland and Lincoln Tunnels, George Washington Bridge and ferries, to determine their points of origin and destination and the travel patterns of this growing interstate traffic.

The Port Authority studies of 1949 and its staff report and recommendations of May, 1950 indicated that a substantial portion of the trans-Hudson traffic had its origin and destination outside of Manhattan and might be bent around this congested island to the north or south by appropriate by-pass routes. Nearly one-fourth of the trans-Hudson motorists had origins and destinations which

might be better served by crossings north and south of Manhattan Island.

As a result of the survey, the Port Authority concluded that those

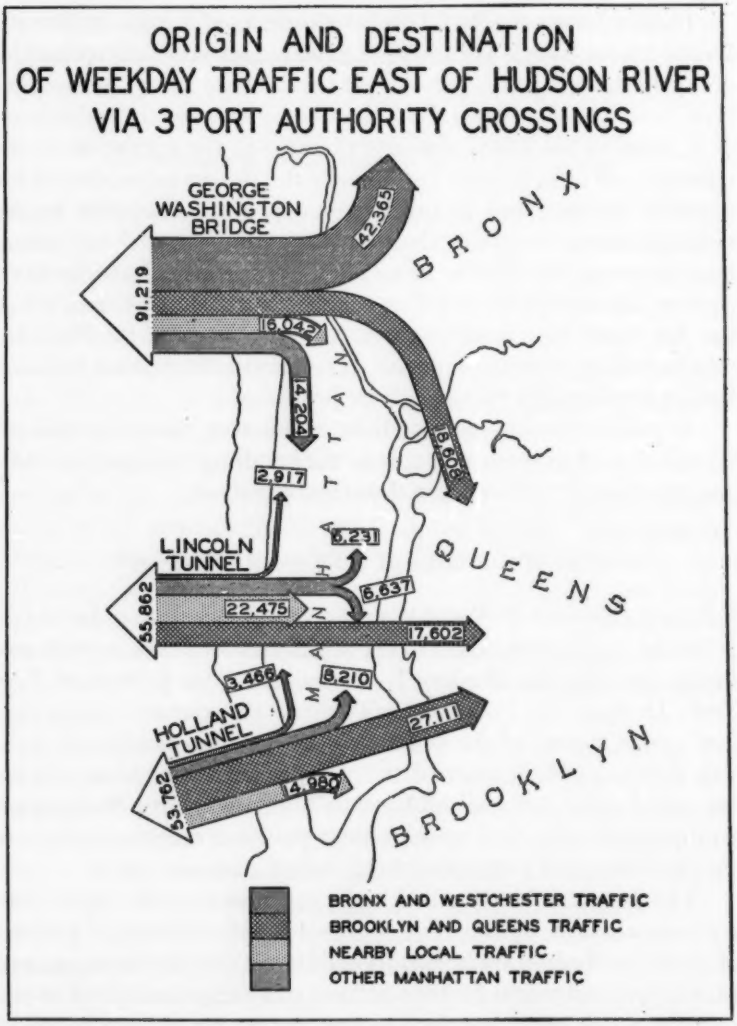


FIGURE 3. Survey shows that 55 percent of trans-Hudson motorists on weekdays have neither origin nor destination in Manhattan.

FIGURE 4. Artist's rendering of widened Weehawken Plaza for three-tube Lincoln Tunnel.

FIGURE 5. Artist's rendering of new 8-block approach roadway in Manhattan being built in connection with Lincoln Tunnel third tube.

vehicles requiring a southerly by-pass route could best be handled by the construction of a bridge between Brooklyn and Staten Island, crossing the Narrows in New York Bay, for which the Triborough Bridge and Tunnel Authority has been given the necessary Federal permit in 1949. A substantial part of the traffic would also be best served by the construction of a new Hudson River crossing north of the George Washington Bridge; the completion in 1955 of the New York State Thruway Bridge spanning the Hudson River between Nyack and Tarrytown will help relieve the need for a crossing north of the George Washington Bridge.

The Port Authority also undertook preliminary studies of the engineering and economic practicability of an entirely new two-tube tunnel between the Holland and Lincoln Tunnels. Such a tunnel would provide a four and one-half mile route extending from the New Jersey meadows to the east side of Manhattan, completely underpassing the central area of Manhattan Island. An estimated cost of $350,000,000 for such a four-lane tunnel makes its construction impractical.

Plans for Lincoln Tunnel Third Tube

At the same time, the Port Authority recognized that the pressure on the Holland and Lincoln Tunnels urgently required early relief in the expansion of trans-Hudson facilities to Manhattan Island. In May 1951, the Port Authority therefore went forward with plans for a third tube of the Lincoln Tunnel.

When completed in 1957, the third tube of the Lincoln Tunnel, expected to cost about $100,000,000, will provide the first major relief to the trans-Hudson traffic problem. It will enable the Lincoln Tunnel during rush hours to double its capacity in one direction when two tubes (or four lanes) are used in the preponderant direction of travel, and will increase its annual capacity by 50 percent. The new tube, to be located south of the other two, will carry New York-bound traffic. The existing north tube will continue to carry New Jersey-bound traffic. The present south tube, which will then be the center tube, may be used to carry two lanes of traffic in the preponderant direction during rush hours or will have one lane assigned to each of the two directions of travel.

On the New Jersey side, the 182-foot plaza in Weehawken will be widened eighty feet to a total of 262 feet. The present left-and-right hand toll booths will be replaced by eighteen driver-side booths to handle the greater traffic volumes and to increase driver convenience and comfort. An additional underpass from the Tunnel plaza will be provided for local traffic.

The New Jersey helical ramp leading to the open cut through Bergen Hill will be widened for westbound traffic from its present thirty-six feet to forty-eight feet for the distance extending from the plaza to the north crossing over Hudson County Boulevard East at the top of the helix. This will add one lane to the existing three westbound lanes for this stretch, thus providing four lanes on the upgrade and three on the down. The viaduct over the meadows linking the Bergen Hill underpass with Route 3 and the New Jersey Turnpike approach will be widened from six to eight lanes. It is estimated that the improvements in New Jersey connections including the required real estate will cost the Port Authority about $11,500,000.

In Manhattan, the Port Authority is providing street connections extending for eight blocks south of 38th Street where the existing south tube and the new third tube roadways emerge. In addition, the new underpass approach will provide connections from 9th Avenue just north of 36th Street and between the tunnel and all cross streets south of 36th Street down to and including 30th Street. These connections will tie in with Dyer Avenue to permit the exit traffic from the existing south tube of the Lincoln Tunnel as well as the third tube to use the new approaches to 33rd, 31st and 30th Streets. Forty-first Street between Dyer and 10th Avenues, 36th Street between 9th and Dyer Avenues, and 30th Street between 9th and 10th Avenues will be widened.

Under this plan, the Port Authority will have constructed all of the essential approaches and connections between the Lincoln Tunnel and whatever crosstown expressway or tunnel may ultimately be built by the city or its agencies. In addition to the widening of 30th Street between 9th and 10th Avenues, the Port Authority will, under an agreement with the City of New York, also widen 30th Street between 10th and 12th Avenues and will provide ramp connections to the West Side Highway at such time as the Lincoln Tunnel traffic reaches 30,000,000 vehicles a year and provided the city obtains the

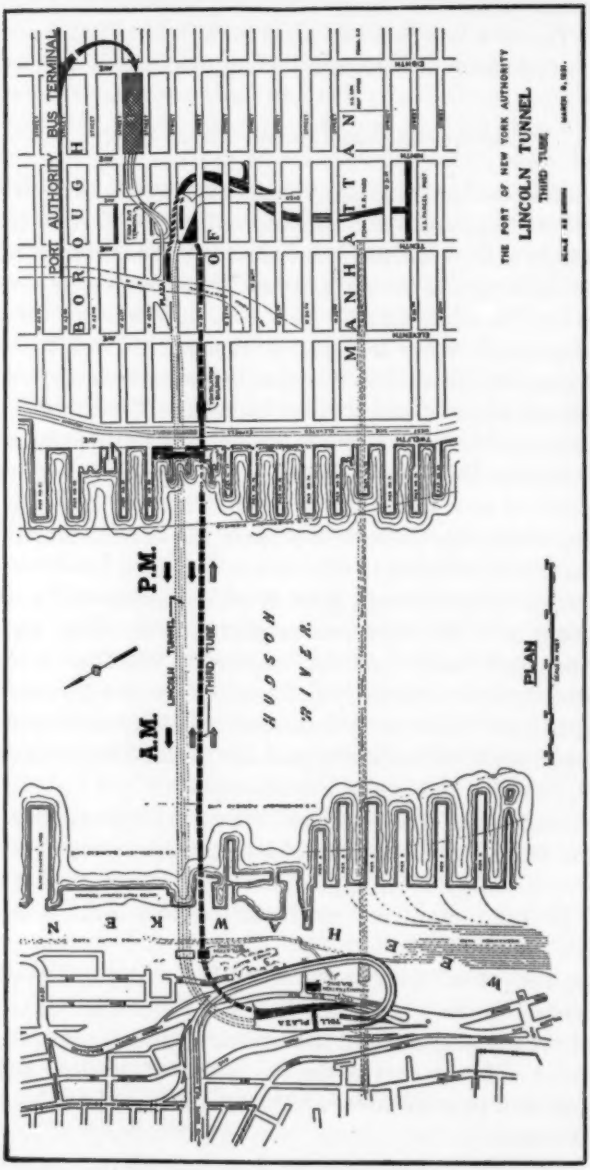


FIGURE 6. Alignment of Lincoln Tunnel third tube together with expanded approaches in New York and New Jersey.

necessary real estate and requests that this work be undertaken at that time. The new approach and plaza work in Manhattan, together with the necessary real estate, will cost approximately $28,500,000.

Constructing the Lincoln Third Tube

Twenty-four construction and purchase contracts on the third tube totalling about $45,000,000 had been awarded by mid-year 1954 and twenty remain to be awarded. Those already under contract include one for construction of the under-river tunnel section of the third tube at a cost of more than $17,000,000, and another for about $10,000,000 worth of cast iron and steel segments which form the basic structure of the under-river section, as well as contracts for major portions of the approaches on both sides of the river.

The task of relocating 832 families who live in properties needed for the third tube Manhattan approaches had been completed, with the exception of two tenants, by the end of September, 1954. With the assistance of a large number of brokers, the Port Authority's real estate department was able to offer to the displaced families a selection of over 3,000 apartments, most of which represented a distinct improvement over the tenements requiring demolition. To facilitate this program and to aid the families in moving, residential tenants who moved voluntarily and unaided received payments of from $150 to $200. When such tenants required the services of a real estate broker, the Port Authority paid the tenant $100, redecorated the new apartment, and paid the brokerage fee.

The Governors of New Jersey and New York approved the third tube plans shortly after the Port Authority announcement of its readiness to build in May, 1951. The City of New York gave its approval in July, 1952 and work started two months later in September.

During 1953, final agreement was reached with the City of New York to demolish the antiquated Hudson River Pier 78, located directly above the alignment of the new tube, and the Port Authority will build and turn over to the city a new $1,300,000 marginal wharf which will provide cover and protection for the tubes of the Lincoln Tunnel.

The agreement also provides for $700,000 advance payment to

the city to compensate for tunnel protective features to be incorporated, as needed, in any new pier built over the tunnel by the city. As part of the settlement, the city agreed that any new finger pier built out from the marginal pier will be so located and constructed as to span and protect the tubes; also the city will at no time permit any work at this location which might interfere with, impair the support of, or impose endangering loads upon the tubes.

Starting on March 26, 1951, the Port Authority reviewed third tube plans with officials of the Township of Weehawken at the New Jersey exit of the tunnel. The construction plans call for using the existing connections of the Lincoln Tunnel in Weehawken approved by the Township when the Port Authority constructed the first two tubes of the Lincoln Tunnel during the 1930's. Even though no new or additional connections with streets or highways in Weehawken are involved in the new construction, as a matter of policy the Port Authority submitted the approach plans for the third tube to the Township for its formal approval.

The plaza plans also involve certain tennis court property, originally provided by the Port Authority and given to the Township when the Lincoln Tunnel was built, and now needed in connection with the third tube. The Port Authority offered to replace it with improved and expanded recreational facilities, as well as other benefits, about six times the value of the tennis court property.

Independent and nationally known consulting engineers selected by the Township of Weehawken, after studying the third tube plans, found that: ". . . . the third tube of the Lincoln Tunnel will provide relief from the serious traffic congestion which frequently occurs on the approaches in the Township of Weehawken many years before any other means of providing relief could be constructed . . . . No serious congestion should occur (on the approach ramps) except when the traffic desiring to use the tunnel exceeds the capacity thereof . . . . The overall plans for improvements in the New Jersey approaches are, therefore, adequate for the presently foreseeable traffic until such time as it becomes greater than the capacity of the tunnel itself."

In May 1954, the Township of Weehawken approved the approach plans and conveyed the tennis court property to the Port Authority.

In the four years since the Authority's survey and report, movement of traffic through the metropolitan area has emphasized the importance of the northern and southern by-passes around Manhattan, which were the keystones of the 1950 recommendations. The completion of the New Jersey Turnpike as well as other arterial expressways and connections, combined with the rapid growth of suburban areas, has had a significant effect on interstate vehicular crossings. To determine the changes in travel pattern experienced during the four-year interval since the previous survey, the Port Authority undertook a new origin and destination survey in August, 1953. One hundred eighty thousand trans-Hudson motorists were interviewed. This survey confirmed the findings of the 1949 survey. It was found that the fastest growing traffic volumes are those which have origins or destinations other than on Manhattan Island. More than 55 percent of the traffic crossing the Hudson River on weekdays and 70 percent on Sundays has neither origin nor destination in Manhattan.

Planning Additional River Crossings

The abnormally large increases in vehicular travel experienced during the last few years made it urgent to go forward immediately with studies of the most effective means for increasing the present capacity of the facilities across the Hudson River and New York Bay. Additional lanes for traffic had to be provided at the earliest possible moment. The volume of Trans-Hudson traffic in the New York-New Jersey Port District, amounting to less than 13,000,000 vehicles in 1926 when only ferries were available to cross the Hudson, had climbed to more than 73,500,000 vehicles in 1953 on the two tunnels, bridge and six interstate ferries. It reached almost 77,000,000 in 1954 and by 1960, the continuing upward trend indicates that the total demand will exceed 100,000,000 vehicles.

The tremendous growth in population and development of Bergen County during recent years has stimulated large increases in traffic volumes over the George Washington Bridge. It was quite evident that this very rapid growth in Bridge traffic, further augmented by the opening of the New Jersey Turnpike and stepped up even more by the completion of great new expressways and parkways on both the New York and New Jersey sides of the Hudson

River, made essential a study of how best to provide additional relief for this Bridge. Further south, the increasing traffic pressures on the Holland and Lincoln Tunnels stressed the urgency of advancing the studies of the possibility of financing and building the Narrows Bridge.

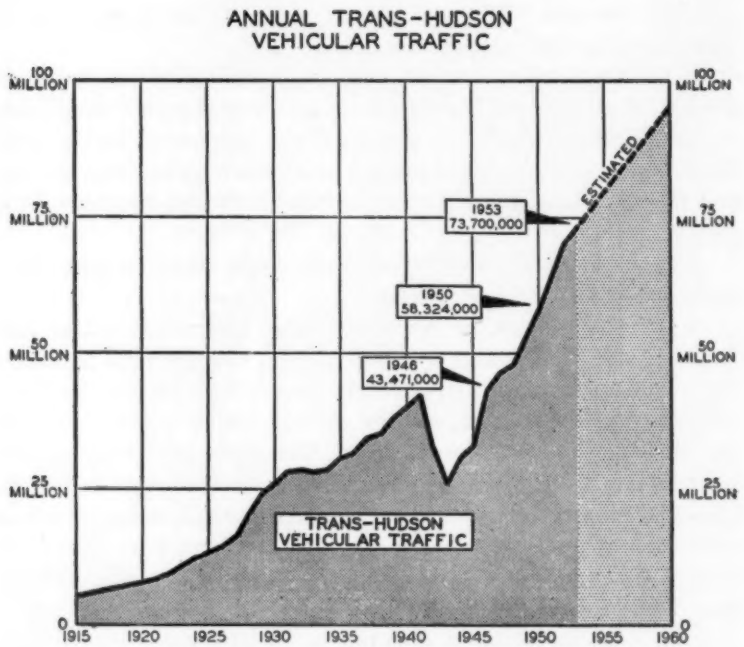


FIGURE 7. Trans-Hudson traffic growth since 1915.

Joint Studies by Port, Bridge and Tunnel Authorities

In February 1954, the Port of New York Authority and the Triborough Bridge and Tunnel Authority began the most comprehensive joint studies of arterial traffic ever undertaken in this area. As the bi-state agency responsible for constructing and operating interstate bridges and tunnels between New York and New Jersey, the Port Authority joined hands in this major study with the Triborough Bridge and Tunnel Authority responsible for bridges, tunnels and related facilities within the City of New York.

To facilitate and coordinate these studies, the two organizations pooled their knowledge, experience and past surveys in joint studies of these water crossings and integrated arterial systems which will provide effective relief of the present congestion and delays of traffic crossing the Hudson River and New York Bay at interstate bridges and tunnels and on their approaches. These studies were undertaken by the staffs of the two agencies with the aid of experienced consultants in their appropriate fields.

Attention is being concentrated on providing by-pass routes to the north and south of Manhattan. As an integral part of these joint studies, careful study is being given to the approaches and arterial highways required to move present and future traffic over, around and through the congested areas of New York and northern New Jersey.

The joint studies by the two Authorities, completed in 1954, embrace the following projects:

1. A new study of the Narrows Bridge between Brooklyn and Staten Island. This bridge will facilitate the development of Staten Island and will provide a by-pass route south of Manhattan for New Jersey-Long Island traffic, and for through traffic moving between the south and west and New England. This study covers expressway and parkway connections with the Gowanus improvement in Brooklyn and the Long Island parkway and expressway system, as well as a new expressway across Staten Island to the three Port Authority bridges leading to New Jersey, the New Jersey Turnpike, Garden State Parkway and Route U.S. 1.

The Narrows Bridge is essential to the direct and expeditious interchange of traffic between New Jersey and the Long Island and New England areas. The heavy traffic between these areas is now faced with serious delays and congestion. These can be substantially relieved by a Narrows Bridge which will permit motorists to avoid circuitous, congested routes and to move directly between New Jersey and Long Island by way of Staten Island.

The Triborough Bridge and Tunnel Authority is authorized by the laws of the State of New York to construct a bridge across the Narrows between the boroughs of Brooklyn and Richmond. In 1949, the United States Government gave a permit to the Triborough Authority to construct such a bridge.

2. A lower level of the George Washington Bridge combined

with new and expanded approaches on both sides of the Hudson and over the Harlem River, to accommodate the increasing proportion of traffic moving between New Jersey and East Bronx, lower Westchester, Queens and Long Island points. In the original design

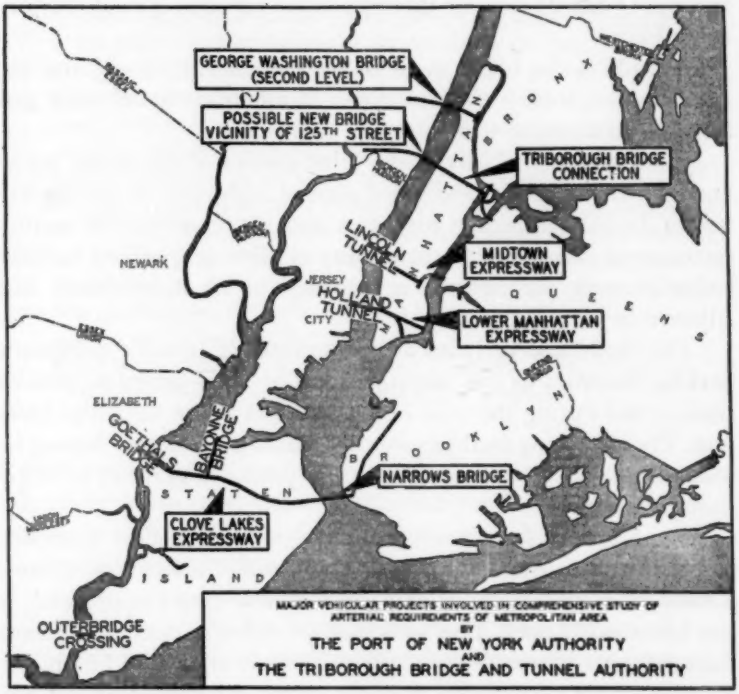


FIGURE 8. Major vehicular projects covered in joint studies by Port of New York Authority and Triborough Bridge and Tunnel Authority.

of the George Washington Bridge, provision was made for a second level below the existing roadway. A study of the addition of this second level for new lanes of vehicular traffic is under way. The approaches and connections on both sides of the Hudson River will be of major importance in this survey.

3. A possible new bridge spanning the Hudson River in the general vicinity of 125th Street, Manhattan, integrated with the Triborough Bridge crossings of the Harlem and East Rivers and the Harlem and East River Drives in New York, and with appropriate arterial highways in New Jersey.

4. Review of the need for trans-Manhattan vehicular facilities (lower Manhattan crosstown expressway at Canal Street and the midtown Manhattan expressway near 30th Street) for local traffic in the light of the possible new by-pass routes across the Narrows and upper Manhattan for through-traffic between New Jersey and Long Island.

A study is also being made of the engineering, traffic and economic practicability of a crosstown Manhattan tunnel near 30th Street as an alternate to an elevated expressway.

5. As an integral part of the joint studies of the major bridge and approach facilities and other arterial highways, all studies having to do with approach highways and expressways will include recommendations as to the possibility of off-street parking facilities either beneath the elevated expressways or on independent sites adjacent to the expressways.

The study also includes an exploration of possible peripheral parking facilities in the outlying areas of New Jersey to provide traffic relief during the peak hours of travel at the vehicular crossings. These parking facilities would be used by motorists bound for Manhattan who wish to complete their journeys by other means of transportation.

The first such facility will be completed by the Port Authority and will be put into operation by the Public Service Coordinated Transport in the spring of 1955 on the New Jersey approaches to the Lincoln Tunnel. This area will permit the parking of more than 800 cars whose drivers and passengers will then be able to board a bus for a quick trip through the tunnel to the Port Authority Bus Terminal in midtown Manhattan.

The joint studies take into consideration the need for coordination with the existing and projected arterial highway systems of New Jersey and New York. They will develop for the years immediately ahead the pattern of construction of new crossings and other highway facilities for arterial travel in this region.

Great studies are thus being made to plan and construct new and expanded vehicular crossings, together with their arterial approaches, needed to handle the traffic in the dynamic New York-New Jersey metropolitan area.

Inadequate Laws

LOUIS R. MORONY

Mr. Morony is chairman of the Highway Laws Study Committee of the Highway Research Board. As director of the Laws Division of the Automotive Safety Foundation, he has for many years worked with states and cities on improving their highway and motor vehicle laws and traffic ordinances. Mr. Morony is a former Assistant Attorney General and Motor Vehicle Director of the State of Michigan; he has served as executive director of the American Association of Motor Vehicle Administrators and as director of the field relations department of the Automobile Manufacturers' Association. During World War II he was on loan from the Foundation to the Highway Traffic Advisory Committee of the War Department. He is a member of the American Bar Association and the Michigan State Bar; member of the Committee on Magistrate and Traffic Courts of ABA, and a member of the National Committee on Uniform Traffic Laws and Ordinances.

THE new "good roads movement," gathering momentum from increased postwar traffic, is beginning to focus attention on the equally urgent need to modernize our highway laws.

Not only have traffic volumes increased beyond belief, but types of vehicles and speeds have changed. The composition of traffic is different. Today's highway problem differs from that of the past both quantitatively and qualitatively. It presents new challenges. It imposes new duties and responsibilities. All these factors, in one way or another, are closely associated with the underlying laws.

Every possible means must be used to clear the obstacles in the way of more rapid highway progress. We must bring to bear the great technological advances made in the construction and operation of road facilities. We must take advantage of improved methods of planning and financing. At the same time we must also make sure we have the best possible law to enable us to modernize our highways without waste, inefficiency or delay.

For the most part, the basic highway statutes of the majority of the states are geared to the horse-and-buggy era of highway development. In many cases highway codes are simply an accumulation of

antiquated and uncorrelated statutes enacted and amended from time to time over the years as the expediency of the situation in each state seemed to warrant. The cumulative result has been a maze of complex, and often conflicting, authority and responsibility that hinders, rather than promotes, sound highway progress.

As recently as July, 1954, the Nebraska Department of Roads and Irrigation, in its publication *Let's Talk Highways,* had this to say about the statutes under which it was functioning:

"The Nebraska road laws are now a collection of poorly amended laws of the 1800's with non-integrated supplemental laws passed by the Legislature to meet the necessity of particular and unrelated special problems. This disorganized mass of archaic law is no longer serviceable. A new highway code with organization is a necessity."

Overhaul of Highway Code Essential

Postwar, many states have made comprehensive studies of their total road needs as the basis for developing long-range highway improvement programs. As a rule, they followed the old-time procedure of trying to remedy obvious deficiencies in their law by adding a legal patch here and there instead of taking a long, hard look at the entire highway code to determine its adequacy for the job ahead.

This problem looms larger and larger with the current acceleration of programs in all states. Federal-aid funds, alone, as authorized by Congress last year (1954), will allocate about $1 billion annually to the states in 1956 and 1957. This almost doubles the sum the states had to match under the previous act covering 1954 and 1955, and represents the highest authorization of federal funds ever made in the history of the federal-aid highway program.

But even this program is not considered large enough to enable us to overcome our highway deficiencies. Plans are now being developed to implement President Eisenhower's proposal, announced several months ago, for a $50 billion ten-year highway construction program to supplement our normal road-building.

Fortunately, there have been some encouraging developments on the legal side. Two events, somewhat interrelated, have drawn national attention to the problem and steps are being taken to do some-

thing about it. One has to do with North Dakota, and the other with the Highway Research Board.

About two years ago, the responsible officials of North Dakota recognized the fact that their highway troubles went far beyond physical facilities—that many of their difficulties stemmed from the basic law. They realized that an overhaul of the highway code was essential, particularly with respect to fixing of authority and defining of responsibilities.

As a result a complete inventory of the highway statutes was made, as part of a comprehensive review of the highway problem which included a study of engineering needs and fiscal requirements. The law study led to a revision and realignment of the state's highway code to provide the kind of legal instrument by which the highway officials at all levels of jurisdiction could carry forward an integrated road program to meet the needs of the state.

Until the law was revised glaring weaknesses and ambiguities existed with respect to system classification, land acquisition, control of access, joint financing and intergovernmental relations in general. Not only were there shortcomings in those major areas but deficiencies were also found in minor provisions which caused confusion and inefficiency.

North Dakota's 'Legislative Intent'

Perhaps the most significant improvement in the highway law of North Dakota was the enactment of a declaration of legislative intent as part of its new highway code.

In it the legislature recognized that the highway official holds a unique position of trust that transcends ordinary administrative functions. This is because decisions with respect to acquiring rights-of-way, planning, programming and construction and many other matters of operating policy, for the sake of efficiency, must be left in the hands of the administrative official. Even the courts are without power to question the discretionary action of the highway official who acts within the scope of his authority with good reason and judgment.

Accordingly, in its statement of legislative intent, the North

Dakota Legislature said, in effect, to its highway officials: We are placing a high degree of trust in your hands and are giving you individual and joint responsibilities for constructing, improving, maintaining, and managing all our roads and streets; in carrying out this responsibility your primary objective shall be to provide, within the limits of available funds, a unified system of adequate highways that will serve the best interests of all our people; within the restrictions imposed upon you by law, the administration of road facilities is left entirely to your wisdom, judgment and integrity.

By this broad declaration of policy, the North Dakota Legislature established a guide for future legislatures. It set up general standards of performance to be adhered to by those charged with administrative responsibilities. And finally, as an aid to the court if litigation arises, it clearly spelled out the intent of the highway law.

Highway Laws of All States Studied

While these developments were taking place in North Dakota, there was pending before the Highway Research Board a request from the executive committee of the American Association of State Highway Officials to sponsor a study of the highway laws of all the states, as a prelude to their modernization and improvement. The outstanding results achieved in North Dakota convinced the Board of the need and timeliness of such a study. A small steering committee, designated as the Highway Laws Committee, was named to get the project under way.

The committee recognized at the very outset that it was undertaking a tremendous assignment. In the first place, it would be dealing with a huge mass of law which was as diverse as it was voluminous. Second, with one or two exceptions, no acceptable yardsticks were available by which the adequacy of the law could be measured.

The committee laid down the following two broad objectives:

1. To assemble and analyze all state constitutions and statutes, including judicial decisions, as they relate to each highway function, such as system classification, highway design, construction, maintenance, land acquisition and others. More than twenty main functional categories of highway law were tentatively listed for research and study.

2. As study of each category was completed, to publish its findings so that

the facts could be used by cooperating and interested groups as a practical guide in developing acceptable basic principles for sound highway laws.

The committee recently published its initial report on state constitutions and the statutes and case law dealing with classification of state primary systems. While this is only a small portion of the total law to be eventually reviewed, it amply confirmed the fact that there is a genuine need for improving the consistency, effectiveness and completeness of our highway statutes.

To begin with, wide divergence was found in the constitutions of the several states, either as they affected the highway function directly, or as they indirectly touched upon this activity in common with other governmental operations.

For example, four states—Arkansas, Louisiana, Missouri and New Mexico—provide constitutionally for the administrative body which is to exercise authority over state highways. The Missouri provision, dating back to 1928, is general. While it provides for establishing a highway commission, the number, qualifications, compensation and terms of its members are left to the legislature.

On the other hand, the provisions in the constitutions of the other three states are of more recent origin and are much more specific. They not only provide for a commission but specify the number, appointment, terms, qualifications, removal and duties of the commission members.

The question naturally arises: Is it good practice to specify the type of administrative structure in the state constitution? And if so, why is it that only four states have adopted such a provision?

Again, thirty-two states have constitutional provisions prohibiting the passage of special or private laws concerning highways. Some of these relate only to vacating roads; others to laying out, opening or vacating. Quite often ferries and bridges, as well as roads, are included in the prohibition against special or private laws, and in some instances toll facilities are included.

Only six states have provisions in their constitutions relating to federal-aid highways, but here too we find that each state handles this matter differently in both substance and scope.

Following is a summary list highlighting the diversity of pertinent subject matter found in the constitutions of the several states:

Constitutional Provisions Affecting Highway Functions DIRECTLY

Authority and responsibility for highways	8 states
State highway administrative bodies	4 states
Special or private laws	32 states
Anti-diversion amendments	24 states
Federal aid	6 states
Special road administrative areas	4 states

Constitutional Provisions Affecting Highway Functions INDIRECTLY

Taking of property	48 states
Internal improvements	12 states
Contracts	4 states
Hours of work	8 states
Taxation	36 states
Indebtedness	42 states

Since statutory law must conform with the authority contained in the constitution, is there not perhaps a need for greater consistency in the constitutions of the several states as they relate to highways?

Similarly, while the report showed that all forty-eight states have classification statutes, there are marked differences in the approach toward establishing their primary road systems. (The laws covering selection of secondary, county and urban systems are still under study.) Proper classification is of course a vital step in developing realistic road improvement programs, and it is certainly open to doubt that all these differing laws are equally effective.

For example, one of the essential provisions of a classification statute vests the appropriate agency with responsibility to designate the state primary system. In twenty-four states this authority is lodged in the legislature. In twenty-three states the highway department has the authority to select the system but in a number of cases this authority is limited by requiring specific legislative approval. Besides these differing methods of primary system selection, there are numerous disparities as to specific details. The remaining state designates the state primary system in the state constitution.

Is one method better than the others and if so, which one? In its report the committee comments as follows:

"Some may hold that the legislature should designate the basic system, leaving future changes to the highway department. Others may feel that the task is a technical engineering job and should be left to technicians in the field. Still others might be for a compromise, under which the legislature would set up classification criteria for the guidance and direction of the highway department, leaving the actual job of classifying to the department.

"A great many challenging questions like this, on fundamental issues, come into focus when highway statutes are impartially examined from the perspective of the whole body of highway law in the forty-eight states, as is now being done for the first time."

System designation is just one aspect of a highway classification law. Other important provisions cover such basic elements as the flexibility of the system, designation of routes in municipalities, mileage limits, official maps, criteria for system selection and others.

Need for Flexibility Obvious

Obviously, there is need for flexibility in the system to permit adjustments as changes occur in land use patterns, traffic needs, or through other developments. Most states provide for such flexibility, but here again we find wide differences concerning who shall have the power to make the necessary adjustments and what the extent of the authority shall be.

Broad legislative authority is given to the highway department in a small group of states to add to, modify, or delete portions of the system as the need arises. On the other hand, in more than half the states the law merely permits the department to make additions, subject to specific restrictions. In some cases the legislature reserves to itself the right to make additions; in others, only to make deletions.

Basic differences also exist as to jurisdiction in designating urban extensions, the important connecting links in the state system of roads. The highway departments in more than half of the states are given the authority to select the urban links but in some cases this authority is qualified.

In Arizona, for example, the selection is subject to agreement by the department and the local jurisdiction concerned. Connecticut has a special qualification which provides that there shall be one

through-route extending approximately north and south and one east and west. In New Hampshire, the state highway department's authority is limited to cities and towns under 2,500 population.

Varied Statutes Lack Special Criteria

Beyond the matter of designation, a whole host of questions can be raised concerning the present varied statutory pattern that exists as between the authority of the state highway department and the local unit involved, or both, over construction, maintenance and operation of urban connecting links.

Mileage limits for the state primary system are specified in a number of states on either a maximum or minimum basis. In one state both maximum and minimum mileage limits are established. If this is a desirable requirement to avoid the dispersion of limited road funds, why shouldn't all states provide for mileage limits? Or can a better formula be worked out for achieving the same objectives?

Probably no feature of a classification law is more fundamental than that providing special criteria to ensure sound system selection. Yet the laws of only twenty states contain yardsticks for designating the state primary systems and these vary from state to state.

For instance, Alabama specifies that the primary system shall (1) connect county seats, (2) be the most direct route possible, (3) be permanent, (4) be chosen with due regard for the public welfare, and (5) provide suitable connection with roads in adjoining states.

The Idaho statute places emphasis in a different direction. While it prescribes that the primary system should include a road to every county seat, it also requires that due consideration be given to the relative importance of each highway to existing business, agriculture, industry, the development of natural resources, present and future traffic volumes, the common welfare, and the capacity of the people to finance improvements.

Indiana provides that highways added to the state primary system shall have a daily traffic volume of at least 200 vehicles, unless the highway connects two existing highways. In North Dakota the commissioner is required to take into account such factors as actual or potential traffic volumes, the conservation and development of the

state's natural resources, the general economy of the state and communities, and the desirability of fitting the system into the nationwide network of highways. Numerous other states have varying specifications with respect to these and other related factors.

"If we tried to extract the substantive elements from the provisions of some twenty states where they now exist, we probably could assemble a list of at least fifteen or twenty specifications," the committee observed in its report. "Maybe all of the items should be in the provision, instead of one or two, as is the case in some states."

Obviously, this is another matter that must be resolved if guiding principles are to be developed as a framework for an adequate and all-inclusive system classification statute. The facts compiled thus far by the committee on just the classification laws covering state primary systems indicate that many issues of equal significance will be raised when the statutes governing other highway responsibilities are fully explored.

Adequate Right-of-Way Laws Needed

Certainly one high-priority area, as state after state gears its highway planning to ten, fifteen and twenty-year improvement programs, is the need to make certain that right-of-way acquisition laws do not impede this orderly development. Are our present laws, which generally provide for such acquisition "when necessary for reasonable future public use," designed to meet this need? What is a "reasonable" period in relation to sound long-range planning? How are the courts interpreting this kind of language in the light of the programming requirements of the highway departments? The committee is now in the process of finding out.

On the other side of the land-acquisition coin is the question of needless delays due to lack of authority to obtain immediate possession or right-of-way when a highway project is ready to go into construction. The condemnation laws and policies of some states make immediate taking possible—while at all times protecting the basic property rights of the private owner—but many states do not include this important provision.

Control of access authority which has made possible our expressway type of facilities has been gaining increasing approval from state

legislatures in recent years. However, while more than thirty-five states now have some form of law authorizing the construction of controlled access highways, it is questionable whether these statutes are all reasonably adequate. The integration of such roads into a national network of highways, particularly in cases where toll-roads may be involved, also poses challenging new legal questions.

A new development that bears watching is a refinement of the control-of-access philosophy which has to do with controlling the *use* of access by agreement or eminent domain, as well as by police power. This involves restricting the kind of use that can be made of access points. The procedure has been practiced with notable success for the past several years in Oregon. In reporting this state's experience with this type of statute to the Highway Research Board last year, Clifton W. Enfield, chief counsel for Oregon's Highway Commission pointed out:

"Not only have private property owners been benefited, but the state as a whole has likewise received benefits, for the maximum development and use of property abutting upon highways that is consistent with safety and highway requirements are thereby promoted, resulting in economic benefits to the state as a whole, as well as increasing the value of private property for tax purposes."

Looking to the future, he said, "As the advantages of access use-control become more apparent to the public at large and to state legislatures in particular, more police power control of use of access to existing and future highways will be possible.

"In light of the ever growing need for access control in the construction of modern highways and the ever increasing cost of such control when effected by exercise of the power of eminent domain, it may well be that police power control of use of access both to existing and future highways, with adequate legislative safeguards to prevent unreasonable exercise of such authority, will receive universal recognition by the legislatures of the several states and universal sanction by the courts."

These are some of the areas of highway law that the committee has on its agenda for study and exploration. Others include intergovernmental relations, traffic engineering, contracts, parking, drainage, bridges, location and design, public utilities and toll-roads.

To expedite the vast job confronting the committee, plans are

now being completed to enlarge its technical research staff. At the same time steps are also being taken to establish an advisory committee which would include representation from all states and many fields. Membership will probably comprise state, county and municipal engineers; highway administrators; lawyers and judges; legislators; city and county officials; planners; economists; authorities on intergovernmental relations; leaders of business and industry.

With the aid of this advisory group, regional forums will be set up to facilitate and extend discussion and debate. Every effort will be made to have the findings thoroughly ventilated. From this unlimited review, there should finally emerge a cross-section of the best thinking and experience as to what constitutes the basic elements in every functional category of highway law. With such practical yardsticks every state will then be able to evaluate intelligently its body of highway law in the light of present and future needs.

Meanwhile, the Highway Research Board project has helped to alert many states to the seriousness of the highway laws problem. Michigan, Nebraska, Louisiana, West Virginia, Minnesota, Kentucky, Tennessee, Illinois and Indiana are among the growing number of states that either have already turned the spotlight on their highway laws or are planning comprehensive appraisals in the interest of providing their highway officials with modern legal tools to enable them to carry out their expanding responsibilities.

Merchandising a Bus Service

HARLEY L. SWIFT

Mr. Swift has been president and general manager of the Harrisburg Railways Company since 1947. For more than thirty years prior to that, he served as engineer and executive for business firms and railway companies, and consultant on transportation problems for more than a dozen companies. His military service in two wars was in the Corps of Engineers in which he attained the rank of colonel and achieved the Legion of Merit. Mr. Swift is a registered professional engineer in Ohio and Pennsylvania. He is a member of the Institute of Traffic Engineers, Urban Land Institute, American Transit Association, and other societies and foundations.

THERE is little difference between operating a bus or transit company and operating a manufacturing business, a department store, an insurance agency, or any business or profession for that matter, including doctors, lawyers, engineers. The success or failure of any endeavor depends entirely on selling the product in quantity at a price to meet all operating costs and taxes, *plus a satisfactory profit.*

Merchandising, or sales promotion, is the process of inducing more people to use the product or services available for sale.

Professional men and transit companies have at least one thing in common. Their services, if not used today, cannot be laid aside and used another day at a lower price, perhaps as an invitation to induce sales of other articles or services. When the hour of production is over, the service and opportunity to serve are gone forever with no salvage possible.

A bus or transit ride is about the only product that the purchaser pays for (usually in advance), watches it being made, and uses completely during the period of manufacture. And when the product (the ride) is completed, the customer has nothing concrete to show for the money he has paid out.

The driver of a 45-passenger bus leaves his outer terminal with a potential gross product of forty-five seat rides. As he drives his bus toward the other terminal, he is producing forty-five seat rides and picking up passengers who buy and use them. If, upon arrival

at his terminal, he has picked up but thirty passengers, he has sold thirty seat rides and the other fifteen become a total loss and vanish without trace or salvage of any sort. The fifteen manufactured but unsold seat rides cannot, like socks or shirts, be put into stock on the shelf for sale tomorrow or six months hence. Unlike metal products if not sold, seat rides cannot later be melted down and again rolled or pressed, perhaps into some other product. A seat ride is most perishable, with no second-hand value.

Factors Influencing Transit Costs

In addition to this perishable feature, other restraining factors of manufacture make the production of a seat ride at a profit difficult. These will not be discussed in detail here, but it is well to consider them briefly.

The first of these restraining factors is rigid regulation by public authority, sometimes by more than one—such as utility commissions, city councils, etc. This regulation embraces not only the wide area of restricted profit of the entire transit operation, but also the narrow area of restricting the selling price of the manufactured product, the individual ride. Further than that, regulation controls the minimum number of seat rides to be produced on given routes and frequently even the minimum number of seat rides to be produced at given times of the day. Finally, the areas in which a transit company may produce and sell its seat rides are generally beyond its control.

Another factor is competition of the keenest type. Although regulation of public utilities is based on the fact that utilities are monopolies or have a monopoly and the public interest must therefore be protected, transit no longer has a monopoly on the movement of people. Transit now has, besides the original competition of "personal locomotion," walking, competitors in the automobile and taxicab—with the serious threat of the helicopter scouting over the horizon. It is not enough that transit has to compete with the automobile, but this particular competitor comes complete with subsidized parking garage authorities, free or less-than-cost on- and off-street storage, special regulations in the form of one-way streets, restricted turns, etc., not to speak of parking fee refunds on

purchases made in stores. All of which militate against the use of transit vehicles, and make them less attractive and convenient.

As a final factor, add the special taxes on transit users by governmental agencies, such as gross receipts taxes, franchise taxes, federal tax on fares, high vehicle-license taxes, none of which is paid by the automobile user.

For a long time opinion prevailed that mass transportation, the transit company, was a necessity in city life; that a city had to have transit, or else. Recent strikes, completely tying up mass transportation facilities in Detroit, Pittsburgh, New York, Indianapolis, Harrisburg, and elsewhere, have demonstrated that mass transportation is not a necessity, but an *essential convenience* to the business life of a city.[1]

In the face of these peculiar, restraining, and competitive factors it is absolutely necessary for one engaged in the fascinating business of manufacturing seat rides—if the manufacturer wants to stay in business successfully—to merchandise his product by *objectively* keeping the advantages of frequent use of buses favorably foremost in the eyes and minds of prospective as well as regular customers.

Ways to Promote Bus Use

Some manufacturers of seat rides, to stimulate use of their product, go in for reduced fares at certain hours or certain days, using the so-called weekday or Sunday passes. Thus the purchaser may ride transit vehicles as much as he likes without the payment of additional fares. (Passes are usually sold at a price equal to the cost of ten or twelve rides.)

In other cities transit sales managers arrange with downtown merchants or department stores, upon surrender of proof of transit travel to the store, to refund or to credit a bus fare on a purchase exceeding a certain amount. A similar cooperative sales-stimulant arrangement frequently is made with moving picture theatres, whereby bus fare in one direction is paid by the theatre on presentation of a bus transfer or other identification indicating travel by bus.

Merchants, department stores, and moving picture theatres have

[1] Hurricane Carol at Providence, Rhode Island, demonstrated the invaluable essentiality of a well-run and well-maintained transit system during a period of emergency—vital for civilian defense.

as much to gain, customer-wise, by paying all or a portion of a customer's bus or street car fare as they have to gain by paying all or a portion of the parking cost for the customer who comes by automobile. By so encouraging the use of buses to shop in town, merchants would undoubtedly aid in reducing traffic congestion. Further, according to a Kansas City survey, which showed that the dollar volume of purchases per customer of patrons who came by transit was higher than that of those using automobiles, they would increase the dollar volume of their sales.

In Harrisburg, to celebrate the ending of a ninety-day bus strike and at the same time induce a quicker return to bus-use for downtown shopping trips, arrangements were made with downtown merchants to cooperate in promoting three days and one evening of *extraordinary* sales. Advertisements called attention to unusual bargains and featured shopping by bus with *free bus rides* into the central business district for the two hours before noon each sales day and two hours after six o'clock in the evening. The merchants of Harrisburg enjoyed their biggest sales days of the year and the return to riding buses as a regular habit, after ninety days' absence of bus service, was greatly implemented and accelerated. Similar sales day arrangements have been made in other cities to stimulate not only bus riding but store sales.

Origin and destination surveys to determine passenger riding habits provide a means of discovering when most riding takes place, to and from where, why, and whether there is a demand or need for bus service in areas presently not served or for direct transportation service between areas now requiring transfers.

The "Welcome Wagon" organization is used by some transit companies to welcome new residents and invite them to use buses to shop, to go to work, to play. Welcome Wagon or other surveys are sometimes used to get samples of customer reaction to transit service from old as well as new residents.

Following up all complaints or suggestions, by personal call and letter from a company official, is a potent way to gain and hold friendly riders. There are times when the refund of a fare to a passenger, where discourtesy or unsatisfactory service is definitely evident, is as beneficial and customer-retaining for a transit company as it is for a department store to return the purchase price to a cus-

tomer for an unsatisfactory or ill-performing piece of merchandise.

Public functions such as concerts, expositions, football games, high school and college events, political rallies, demonstrations, parades, circuses, store openings, conventions and community projects, ground breaking, ribbon cuttings, crowning of queens all furnish an opportunity to demonstrate and talk about the convenience and freedom from traffic and parking worries for those who "go by bus." Special bus service directly to and from such affairs—whether at regular fare or a special fare—frequently can be operated profitably or at least sustain itself with beneficial results by enticing the harried motorist (trying out this special service) to use buses in his regular daily travel, a habit changer, so to speak.

Cooperation through granting the use of car cards, advertising space, sharing radio time, and particularly through active participation by capable key company personnel in Community Chest, Red Cross, and other welfare campaigns—all these are excellent indirect methods of keeping the product, bus rides, in the limelight of favorable opinion and frequent use.

A typical American has two distinguishing characteristics. Whether or not there is a reason for it, he is always in a hurry to get where he wants to go. He insists on comfort and convenience. Alert bus companies cater to both of these characteristics. For the long distance or suburban rider, express or non-stop buses are operated sometimes at a premium fare with the overall riding time reduced from two to ten or fifteen minutes. Limited-stop buses, making certain stops rather than all stops, with a psychological saving of time, are frequently offered as an attractive convenience. To care for the intermediate rider on lines where express or limited-stop buses are operated, an increased frequency of local bus service is given, assuring the short rider of more seats and less crowding, giving him a feeling of personalized service. These services have been resorted to with varying success by transit companies endeavoring to retain or increase the number of riders.

Personalized Bus Service

A few of the ideas used in Harrisburg and no doubt in many other places to promote sales of bus rides are printed bus schedules,

Fringe Parking: Merchants, City, and Bus Company cooperating.

"Open Air" Bus.

maintenance of an information booth at Builders Show, the Farm Show, and other events at the State Farm Show Building, an occasional birthday gift of a pair of bus tokens to service club members sitting at the "birthday table."

The high cost of wages and many feather-bedding provisions of labor contracts have made the old-time scheduling a streetcar to come down the street at regular intervals of five minutes, ten minutes, or half hour, too expensive and obsolete. Nowadays printed schedules for each route, showing the time buses leave the terminal and intermediate points, are printed and distributed to passengers and prospective passengers. This service not only enables the company to avoid having buses stand unproductively at the end of the line to meet a regular spacing, but it also keeps the passenger, who soon learns to use and read his schedule, from going to his bus stop and standing needless minutes before the bus arrives. Keeping the passengers from minutes of impatient standing at the corner also cuts down the chance of losing him or her to a generous neighbor "going my way" in an automobile.

A schedule in a purse, on the hall table, or in a billfold is a constant suggestion to ride the bus. Neat and practical green and silver plastic "Time 'Tainers" are supplied to protect the time table. Schedules are distributed by bus drivers for several days after bus times are changed and kept on tap in their kit boxes thereafter. Frequent house to house distribution of time tables by uniformed employees, with sporadic stops to discuss advantages of using bus service with residents who answer the door bell, produces new and retains old customers.

More important in retaining riders than providing printed schedules is maintaining schedules, *on time performance!* Constant endeavor to accomplish this feat and evidence of this constant effort with the appearance of top management personnel on the street when the going is bad, build up the bus rider's confidence in the regularity and dependability of bus schedules and encourage recurring use of the service provided.

Attendants at information booths in exhibitions and shows are instructed to be able to answer questions with regard to exhibits, their location and content, as well as questions on transportation matters. Usually a "give-away"—one year, matches; another year,

"Time 'Tainers," with some slogan such as "How Far Away Did You Park Today? Ride the Bus" imprinted thereon—is handed to each seeker after information at the booth. Care is taken in selecting the give-away and seldom are they abandoned or thrown away.

Packaging bus tokens or tickets in an attractive gift package and calling attention to the practicability of a gift of bus rides are successfully practiced in several cities, with a noteworthy and satisfactory recurring demand for the gift packages each Christmas. A sale of a thousand gift packages a season is not unusual on a small property.

In talking with automobile clubs, traffic engineers, civic development associations, and merchants, we consistently assume the attitude that all areas cannot be economically served by buses; that to attempt to do so would spread service too thin and mean poor bus service everywhere; that we welcome the use of the private automobile wherever it is the practical and economical vehicle to use. We encourage combining the use of bus and automobile as a convenient time saver and to lessen congestion in downtown areas, advocating that those who live in suburbs or areas that cannot support bus service, drive their automobile to a convenient point on a bus line, part it, and go the rest of the way by bus.

A recent novel variation[8] of the park-and-ride idea to increase sales of bus rides is an arrangement with gasoline filling stations to permit parking of automobiles on the filling station aprons while the occupants of the automobile complete their trip downtown by bus. This scheme has a four-way benefit: it puts riders on the bus; it develops the sale of fuel, grease jobs, and washing for the service station; it reduces the congestion downtown by keeping those cars off the business streets; and, finally, it encourages business in the vital central business district.

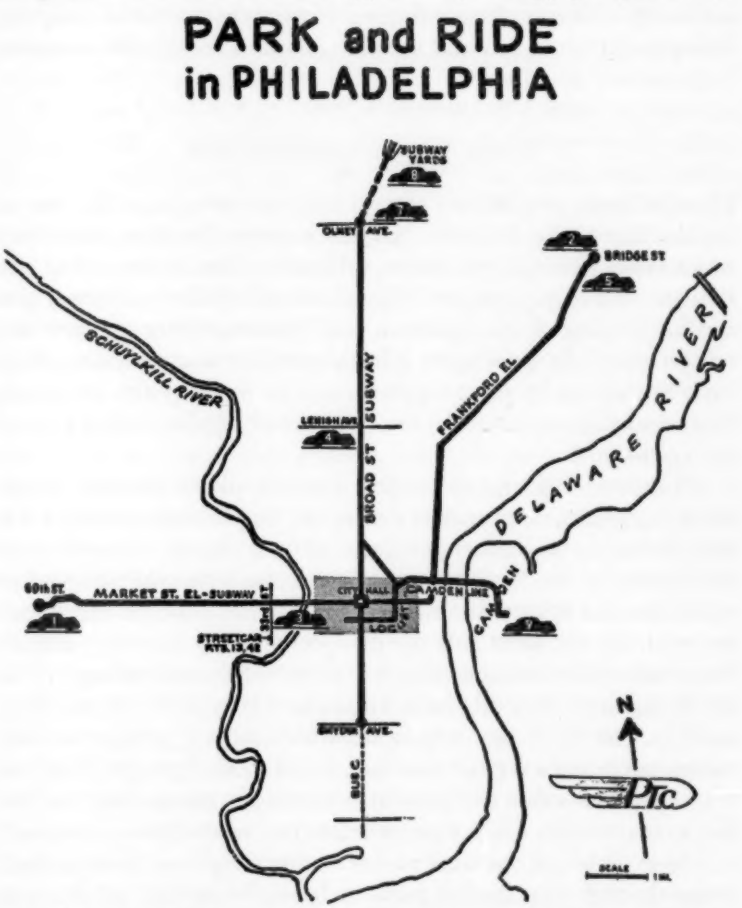
Presenting the Product Favorably

Americans prefer to do things the easy way, the modern way, the quick way much more than the economical way. Americans are not attracted because an item is *cheap,* but how they love a bargain!

Through daily use of radio, television, and newspapers we

[8] United Transit, Providence, Rhode Island

adroitly keep before the motoring public and our patrons the idea of convenience and freedom from parking and traffic worries when using buses. We never miss an opportunity to supply a speaker for



any club or gathering, not necessarily on traffic or transportation, but on any subject with which the speaker is authoritatively conversant. The mere presence of the speaker under transit company auspices provides the opportunity to talk about transportation problems and to encourage the use of buses.

Membership and full participation of bus company employees

in the activities of service, civic, and business clubs are encouraged and underwritten because management believes the association and fellowship developed in these clubs are invaluable in bringing about a friendly understanding of the problems of customer and company. Everybody likes to buy and use the product a friend sells or makes. It is a natural reaction.

Clean, Attractive Buses Pay Off

Charter buses provide an opportunity to encourage the use of regular bus service because men and women who have never used bus service, perhaps have never ridden in a bus before, often participate in a group project. Cleanliness of the bus, courtesy and careful driving of the operator, and the surprising comfort and relaxation of the passengers—plus a complimentary remark about daily bus service by some regular bus rider in the party—are sparks that encourage a trial use by the non-user of regular service to shop or to go to work.

Chartered bus trips to historic or scenic places, through manufacturing plants, or to special events can be planned, arranged for, and sold to parent-teacher groups, to church circles, to chambers of commerce. In the local area regular service buses are assigned to such trips; for longer distances parlor coaches with reclining seats are used. On the short ride the prospective daily customer realizes how comfortable and convenient the bus he has seen rolling by him on the street so smoothly each day, as he warily drove to the office, really is. On the longer trip in a parlor coach, a prospective customer, not being a regular bus user, is not so likely to get tired and draw an unfavorable comparison between his automobile and the bus, so he, too, gets a desire to "ride the bus—where there is no fuss."

Open air buses, operated on hot summer nights or Sunday afternoons through cool shaded parks or beautiful residential districts, while not always profitable, build up friendly relations and encourage the use of regular service. Even the most sedate of us are youthful enough to feel the urge to "ride in a convertible." At most this peculiar-looking vehicle, rolling over the streets with its load of happy passengers, always attracts attention and reminds the viewer that buses are used and enjoyed, and are convenient.

A bus painted to look like a Christmas package, lettered "Merry Christmas and Happy New Year" and operated in regular service on a different route each day, was a decided stimulant to bus riding in several cities. No parent can resist a child's plea to ride on the pretty bus. The good will generated by this simple and inexpensive device is still felt in our town.

Frequent visits and personal discussions of current transportation and traffic problems with the key persons of department stores, the police department, city council, planning commission, newspapers, radio and television stations, real estate groups, chamber of commerce committees (particularly the merchants, convention, and new industry committees) by competent transit company officials, keep before the public the necessity of encouraging increased use of public transportation as an important and inexpensive means of imdiately relieving traffic congestion and increasing sales in the downtown area.

Clean, well-painted, dent-free modern buses are the best salesmen of all. A clean, shiny modern bus is to the sale of seat rides what a streamlined stainless steel and thermopane glass store front is to a specialty shop. We in Harrisburg make almost a fetish of washing, sweeping out, and dusting our buses each night. No bus with a noticeable blemish from an accident is allowed in regular service any longer than it takes to get another bus out of the garage to replace it.

No bus with initials scratched on seat backs or side walls is permitted on the road, and inspection of interiors for damages of this kind are made nightly. It is our opinion that undented and unmarked buses prevent and delay the first scratch and cause customers to treat their traveling home and its furniture with the same respect they give to their own home and furniture. No one wants to put the first mark on a new, shiny car and that holds true for a bus. A clean, shiny, unmarked bus attracts customers and tends to reduce accidents.

A Psychiatric Laboratory Is Planned for New Centralized Traffic Court

EDWARD S. SCHEFFLER, LL.B.

Mr. Scheffler was elected Chief Justice of the Municipal Court of Chicago on November 4, 1941, and twice re-elected. He was admitted to the Illinois bar in 1916. Following five years of private practice, he was appointed assistant prosecutor for the City of Chicago. He was assistant probate judge to Judge Henry Horner from 1926 to 1930. He was then elected judge of the Municipal Court for a six-year term and has remained with that court. He is a member of the American, Illinois, and Chicago Bar associations. He recently received the John Howard Award for outstanding public service to the correctional field.

DRIVING reflects the driver's true personality. Years of critical study show that chronic traffic offenders are not only problems while driving, they are social misfits.[1] Dr. Robert J. Stack, director of New York University's Center for Safety Education, says many persons become neurotic drivers because we have not yet developed a code of good conduct for automobile traffic. The basic rules of good manners in many phases of everyday activity should apply equally on the road. A car is a dangerous weapon in the hands of neurotics or physically unstable drivers. Seventeen years ago, a special safety or traffic clinic was recommended by Dr. David B. Rotman, then director, Psychiatric Institute of The Municipal Court of Chicago.[2] During those seventeen years, the Psychopathic Clinic of Detroit discovered 100 drivers were so disturbed before fatal accidents that they belonged in hospitals rather than in automobiles. The clinic screened out 850 feeble-mined or borderline drivers and 1,000 former mental-hospital patients whose emotional problems were getting them into trouble. The important thing about a driver is not his reaction time, as many think, but his attitude.

Since the invention of motor vehicles, much has been written about the infinite number of problems the automobile has given to

[1] Canty, Alan: "Road Hogs is Hogs—Anywhere," *Detroit Traffic Safety Bulletin*, January, 1954.

[2] Sharp, Agnes (Editor): "David B. Rotman, M.D.: Addresses and Papers, 1934–1948," page 127, The Psychiatric Institute of The Municipal Court of Chicago, Chicago, 1948.

the courts for handling, both in property damage and personal injury and in drunken and reckless driving, reckless homicide, etc., but in recent years an innovation in our jurisprudence has been added—the use of the courts as agencies to determine whether the defendant shall exercise the privilege of driving a car.

The traffic judge no longer deals solely with the issue as to what facts occurred and what the punishment shall be. He has a duty as society's agent to say whether the defendant before him is qualified physically and psychologically to drive a car and how long he may be deprived of the right to drive.

In the State of Illinois, by recent legislation, the Secretary of State has received the power to revoke drivers' licenses. He has adopted the policy of acceding to the judges' recommendation, and in serious cases, upon finding a person guilty of drunken driving, reckless homicide or leaving a scene of accident, the revocation of one year is mandatory.

The automobile industry is far ahead of the traffic engineer and the traffic courts. By mass production, and the change in society's use of the automobile as a means of transportation instead of a luxury car, traffic engineers and traffic courts have been forced to follow the lead of the manufacturers instead of leading.

The need for trained help to assist the judge in cases where either physical or psychological factors are present or are suspected must be provided before the court's decision can be made. In the stream of cases through automobile courts, it is only the exceptional cases that call for assistance. It is the exceptional cases that are the dangerous ones—so far as society is concerned.

The value of professional assistance in cases involving abnormal physical or psychological factors is as apparent here as in any other court.

Until all states adopt stringent driver tests, the automobile courts will have an additional burden of weeding out the unfit, and for that they need trained professional help.

Forty Million Worlds

In an article entitled "Forty Million Worlds," Agnes A. Sharp, Ph.D., then the chief psychologist and assistant director of the Psychiatric Institute of The Municipal Court of Chicago, said:

"There are about forty million individuals driving automobiles in the United States.[3] And each car, while it is rolling, is driven by a person whose style of life, interests, and activities make up the specific private world in which he lives, plans, dreams, thinks and acts. He takes his world with him when he climbs behind the wheel of his car.

"The problem of reducing still further the number of automobile accidents and deaths points more clearly each year to the necessity of understanding these private worlds of drivers. There is a good deal of talk about safety education and much timely activity in accident prevention work, but little comprehensive research in driver behavior is being carried out.

"We must know whom to educate and how to do it. We need to study not only the knowledge and skill of these drivers, but their emotional adjustments, their social attitudes, environmental and job adjustments, home adjustments, and their typical reactions in crowds. We should search out the eight or ten major psychological causes of automobile accidents, that we might then devise sound ways of eliminating their causes.

"This article does not deal with a research project, but a service job we have been rendering the automobile courts of Chicago. There are thirty-six branches of the municipal court. Three of these are automobile courts. The Psychiatric Institute serves all thirty-six branches. Judges sitting in the courts send persons under arrest for examination. Obviously, these are selected cases that we study.

"For many years some drivers who have been arrested were examined and diagnosed here. But about four years ago we became acutely conscious of the lack of techniques for intensive examination of traffic offenders who were referred to us in ever increasing numbers.

"Since then we have been trying to develop adequate psychological and psychiatric tests. Our is a diagnostic clinic. Not by choice, but by necessity, have we been studying the problem of driver behavior. What motivates him to break laws, to crash into things, to destroy his own and others' property? The findings reported are by-products of this service job.

"It is a truism to point out that an automobile is no longer a luxury pleasure car, that the old sporting rules of politeness and graciousness on the part of the more privileged no longer operate, that the automobile has become a means of getting between two points in the quickest and most comfortable fashion. All of us drive. Drivers are a good sample of the population, and mere regimentation and regulation, it seems to me, must give way to valid tests of driver adequacy, with privileges withdrawn where inadequacy is demonstrated.

"Licensing to drive is analogous to private employment and the training of workers. We know that for some kinds of work persons with low intelligence or with physical handicaps are inadequate for certain jobs. In this and other extreme cases in industry it is not necessary to make elaborate job analyses

[3] PUBLIC SAFETY, Vol. 15, No. 6.

and specifications. So in drivers, we do not need elaborate research or comprehensive examinations in the extreme cases. We know what to do in extremes. But for the great middle group of drivers, Mr. and Mrs. Average-Driver, we need controlled research along psychologic and psychiatric lines.

"In an effort to help the automobile courts solve a very practical problem, without standardized driver testing techniques and without psychophysical equipment, we developed an examination covering forty items.

"The staff of the Psychiatric Institute, a resource department of the court, is directly responsible to the chief justice of the municipal court and his associate judges. . . .

"One of the main reasons the staff of the Psychiatric Institute was interested in making the effort to draw up for tentative use a comprehensive and intensive examination for a particular type of offender was that the techniques developed in such a fashion might prove to be useful in examining persons arrested for many other types of offenses.

"In detail, each examination has the following major angles covered in a uniform fashion:

"1. A complete statement of the violation or accident, with the surrounding incidents, is given to us verbally by the arresting officer.

"2. The complainants are interviewed and their stories recorded.

"3. Relatives of the person under arrest give us a complete psychiatric social history, tracing the development of the individual.

"These three outside sources give us background against which to project the findings of our tests of and interviews with the driver being studied.

"The examination of the offending driver is five-fold:

"1. The locating of definite physical handicaps; for example, diseases with syncopal tendency such as diabetes, cardiac, epilepsy, narcolepsy; others which cause the clouding of consciousness as in venereal disease; the visual defects such as tunnel vision, blind spots, double vision, color blindness, and lack of ability to discriminate brightness contrast; further, the dulling of sense acuity, slowing down of perception, impairment of memory.

"2. An evaluation of the mental ability of the driver. In addition to at least one standard intelligence test, simple tests of arithmetic and reasoning and a drawing test for visual memory are given. This last drawing test is reliable for determining mental deficiencies and the major psychoses. To determine the presence of a psychosis a psychiatrist, in interview, evaluates the present typical mental processes. It has been found that persons suffering from certain serious neuroses and some psychoses are definitely unsafe drivers.

"3. In determining a driver's knowledge and skill in driving an automobile we question him about his training in driving. We present copies of the basic road signs and ask him to explain what the sign means and what he must do in each instance.

"4. As a further and objective test of his driving ability the driver is given a road test.

"5. In addition to standardized personality inventories, in interviews with at least three staff members we have attempted to study and evaluate the emotions and attitudes of these drivers. We went into the individual's work record very carefully, his ability to hold a job, to get along with his boss and fellow workers, his marital history and home adjustments; his driving history and its problems, his general state of well being and happiness.

"Such an examination takes about six hours' time of people already skilled in testing and interviewing. In finding items that are important, this is justifiable. As a practical examination it needs to be cut to at most one-third that time."

Chicago Awakens to Its Traffic Problems

More activity in traffic improvement is resulting in Chicago now than at anytime in the city's history. Progress is being made to correct the traffic conditions that cause both economic waste and personal tragedy. Illinois has a new driver's license law. Traffic courts and police traffic operations will be centralized in one building. Law enforcement by police and courts has greatly improved. Engineering projects have been accelerated. More and more streets are being designed for one-way traffic. Construction of new off-street parking facilities is being speeded.

The Citizen's Traffic Safety Board of Metropolitan Chicago is a privately financed organization. Its purposes are to stimulate all governmental actions that will improve the flow of traffic and by educational means to bring about on the part of drivers the degree of law observance and careful, courteous driving that will keep accidents at the minimum. The managing director is Franklin D. Sturdy, long identified with traffic improvement effort in Chicago.

Of the three factors effective in achieving the goal of safer and more efficient street traffic, we shall leave the special problem of traffic engineering to governmental officials, the problem of education to the efficient handling by the Citizen's Traffic Safety Board, and concentrate this study on enforcement by the court. "There is a point below which the quantity of enforcement is too small to have any effect. This is like driving a nail. If you don't hit it hard enough it won't budge. In enforcement, this is surely the case when arrests are fewer than accidents."[4] Chicago's traffic division was reorganized in 1948. Prior to this, traffic law enforcement was so poor as to have

[4] Report of Committee on Enforcement of the President's Highway Safety Conference.

little or no effect upon careless and reckless drivers. Since that time it has improved considerably. In both Detroit and Los Angeles, the safest large cities in the country, the accident rate has been found to rise when the number of arrests for hazardous moving violations falls below thirty for each accident involving death or personal injury.

The rate of police enforcement during the first six months of 1953 was the highest in the city's history. During that period the ratio of arrests for hazardous moving violations to fatal and personal injury accidents was twenty; Chicago's most respectable showing, still below the goal of thirty that can be expected to keep the accident rate at a reasonable level.

The total arrests represent less than one-tenth of one percent of the approximately 800,000 drivers assumed to be on the Chicago streets. The number of arrests for hazardous moving violations by city police on a typical day follows:

Moving Arrests in 24 Hours

Violations	
Driving While Intoxicated	8
Reckless Driving	59
Speeding	92
Leaving Scene of Accident	23
Wrong Side of Road	13
Following Too Close	16
Improper Start from Parked Position	3
Defective Lights and Brakes	42
Obey Signs and Signals	147
Outside Authorized Lanes	6
Obstructing Traffic	28
Failure to Make Turning Signal	2
Violating Vehicle Right-of-Way	8
Violating Pedestrian Right-of-Way	13
Improper Turning	127
Through Street Stop	56
One Way Traffic	26
Passing Street Cars	6
Driving Through Safety Zone	3
Improper Passing	24
Other Driving Violations	10
Total Hazardous Violations	712

The final phase of enforcement lies in the courts. Prosecution and adjudication of traffic violation cases have improved. After public attention was drawn to the situation in 1951, the percentage of convictions for drunken driving in the municipal court rose from only about 15 percent to 75 percent. Courts, abandoning the old policy of almost casual leniency, have adopted a realistic attitude in keeping with the often fatally dangerous nature of the offense.

Improved court procedures will be hastened by the centralization plan brought to a successful conclusion when the city purchased the Reid-Murdock Building on LaSalle Street and the River. Beginning in early 1955 this one place will house the Court, the Police Traffic Division and the Violations Bureau. The improved facility for record keeping and court supervision will increase court revenue by at least $1,000,000 a year, it has been estimated. The violations bureau records to identify repeated violators and penalize them on a rising scale of fines for second and third offenses will also be easily available for guidance in sentencing defendants after their conviction. The Citizen's Traffic Safety Board has advocated that the courts adopt clinical methods as an alternative to conventional penalties in suitable cases. They recommend lectures, psychological and physical examinations, instruction in traffic laws and safe driving practices, and other techniques successful elsewhere.

Clinical techniques in an expanded traffic laboratory will be invaluable in supplementing reports required by the new Illinois Driver's License Law to be made to the secretary of state on all convictions of hazardous moving violations.

Chicago Studies Detroit Program

In September, 1953, Chicago's traffic law enforcement administrators and the city architect visited Detroit to study that city's traffic court program preliminary to completing final plans for the consolidation of Chicago's widely scattered centers of traffic law administration.

After a preliminary survey including New York City and Los Angeles, it was decided to model Chicago's new traffic court system partly on the Detroit plan, using some of the features worked successfully in that city. Centralization is the only common sense answer

to any traffic program in which the courts must process 2,200,000 traffic tickets annually. Added revenue and stronger enforcement impact will be derived from more efficient operations of these courts. Consolidation will be a great convenience to the public because of the central location and nearness to the Chicago loop. The change has been acclaimed by lawyers who will no longer lose valuable time traveling between their offices and various courts. Police will be saved thousands of manhours now lost in travel, and police and court coordination is expected to improve 100 percent. Plans call for a large assembly room, from which cases will be assigned to court rooms by loud speaker, five large court rooms, and five rooms for cases to be heard by referees. Motorists wishing to plead guilty to a violation will be served promptly at counters and cashier cages located near the front of the building.

Space is being set aside for a school for traffic violators, to which judges may send teen-agers and other violators who, the judge thinks, would benefit more from this type of penalty than from a punitive one. Police officers will be assigned to assist the public and to keep order. The number of bailiffs will be reduced. The dignity and decorum of the courtrooms will be vastly improved. It will be possible to maintain an effective accident-repeater file, and to provide judges with previous conviction records of litigants. The entire enforcement program will be strengthened by faster processing of traffic cases, and prompt follow-up action by police in cases where motorists ignore summonses to appear.

Enabling legislation, authorizing the establishment of the Psychopathic Clinic of the Recorder's Court, City of Detroit, was enacted by the Michigan State Legislature in 1919, and the Clinic has been functioning uninterruptedly since 1920. Significantly, the Recorder's Court differs from most municipal courts in that it has jurisdiction of all criminal offenses, felonies, and misdemeanors alike, when these offenses have been committed within the corporate limits of the city of Detroit, exclusive of offenders under the age of seventeen years. In 1930, the Recorder's Court was recognized and a separate division known as the Traffic and Ordinance Division was established, and there were occasional referrals to the Psychopathic Clinic, but only where there was a question of insanity. In October 1936, a new division of the Psychopathic Clinic, popularly known as

the Traffic Clinic, was opened and a special appropriation was granted by the Common Council for this purpose.

The Detroit Traffic Court thus became the first organization of its kind to study special psychological and psychiatric traits of problem drivers on a formal basis. This Traffic Clinic will complete eighteen years of service in October, 1954. The Psychopathic Clinic staff is composed of three full-time psychiatrists, one general physician, who performs routine physical examinations, five senior clinical psychologists, all of whom have their doctorate in psychology; five junior clinical psychologists, who must have a master's degree in psychology, ten medical stenographers and an executive director who is a psychologist.

In addition to the service of the executive director, one psychiatrist is assigned full time to the traffic division and one other psychiatrist divides his time between the criminal division and the traffic division. There are two full-time psychologists assigned to traffic duty, and two stenographers. The service of the general physician for the clinic in the performance of physical examinations is also divided between traffic division and criminal division. In 1953, the total examinations of the psychopathic clinic numbered 2,519, of which 854 were referred to traffic clinic. All referrals to the traffic clinic were made by the two judges sitting in these court branches and made *subsequent to the conviction* of the individuals but *prior to sentence.*

The total budget for the psychopathic clinic in 1954 is $159,821. The part allocated to the traffic division of the psychopathic clinic cannot be stated exactly because of the interlocking complications and the division of time spent by some personnel who work both in the traffic and criminal divisions, but it is estimated to be $48,000.

The expense of the psychophysical equipment at the Detroit clinic was difficult to obtain and may not advisably be used in estimating present costs for such needed equipment because this equipment, for the most part, is many years old, and parts of it were built at the order of the clinic years ago. We were informed that the American Automobile Association and several other companies are now furnishing this type of equipment, but no recent catalogues or price lists were available.

In the calendar year 1953, the total cases closed by the traffic court

numbered 897,120. Of this number 159,016 appeared before judges and were found guilty, the remainder falling into what is generally known as "cafeteria" type of cases. This number convicted in court, then, represents the "pool" from which the referrals to the traffic division of the psychopathic clinic were made. This represents a figure of six per one thousand convictions. While this percentage appears to be small, efforts have been made to hold the referrals down by the use of specific criteria because of limitations of space, budget, and personnel. Nevertheless, in this relatively small percentage of referrals, the psychopathic clinic has in its files, records of more than one hundred committably insane individuals driving cars on the streets of Detroit, and approximately one thousand former inmates of hospitals for the insane.

The clinic has found approximately 850 feeble-minded or borderline feeble-minded drivers in addition to large numbers of emotionally unstable, impulsive and irresponsible persons, alcoholics, senile and arteriosclerotic individuals and those with visual or other handicaps which make them problem drivers. The clinic has consistently found about 2 percent of the referrals to be subject to epileptic or other types of convulsive seizures. In seventeen years, since the traffic clinic started, it has examined almost 10,000 traffic court referrals. The criteria used by traffic court judges for referrals is as follows:

1. The complaint of the arresting officer that the offender behaved peculiarly or in an unstable manner at the time of arrest.
2. Unstable or peculiar behavior in the court room.
3. The presence of alcoholism.
4. The presence of physical handicaps or the offering of an illness as a defense.
5. A history of previous hospitalization for mental illness.
6. Repeated offenses or length of the individual's traffic record.

Recently, referrals are being made to the traffic clinic in instances where licenses have been suspended and the offender applies for reconsideration and restoration of his driver's license and privileges in a shorter period of time than was originally ordered by the court.

The complete clinical examination may take three to four hours on the average. Each person referred to the clinic is given a physical

examination as far as is warranted, a blood test to rule out the possibility of a venereal disease, a driver's test, and as detailed a psychological examination as appears to be necessary to reveal personality defects and personality maladjustments. A detailed psychiatric and social history is taken and the arresting officer, complainant, and relatives are interviewed. The patient is put through a battery of psychophysical tests which require specific equipment in order to determine the offender's defect in vision, hearing, coordination, reflexes, depth perception and ability to handle an automobile in various driving circumstances.

From this combined and extensive examination, a report is compiled and sent to the referring judge with a summary and evaluation. Recommendations of the traffic clinic were followed by the judge of the traffic courts almost 100 percent. It was the opinion of Judge George T. Murphy—and the study group was informed that it was also Judge John D. Watts' opinion—that the traffic clinic is a valuable adjunct to the traffic court, and played a significant part in reducing serious traffic accidents, and in reducing the recidivism rate in the traffic court.

Suggested Plan for Chicago

Dr. E. J. Kelleher, Director, Psychiatric Institute, the Municipal Court of Chicago, surveyed the psychiatric facilities of the Detroit program and made recommendations in a report to his chief justice.

"The advisability and need for such facilities must be first considered. By mid-August, more than 200 persons had been killed so far in this calendar year by traffic accidents within the confines of Chicago, Illinois. In that same period of approximately one-half year, more than 16,000 persons have received injuries in traffic accidents. In Cook County, in the first half of 1954, the death toll has risen to more than 300. Reports indicate that the number of drivers is steadily on the increase, likewise the number of traffic offenders.

"These figures alone appear to make the problem serious enough to warrant attacking it by all reasonable means. Statistics obtained at the Recorder's Court Psychopathic Clinic, Traffic Division of Detroit, Michigan, serving a smaller city than ours and involving a smaller number of drivers and traffic offenders, (population of Detroit, 1,849,568—Chicago, 3,620,962, latest census; total traffic offenders 300,000 more in Chicago than Detroit, 1953), and other reports obtained from a variety of sources throughout the United States indicate that there are considerable numbers of problem drivers due

to medical, neurological and psychiatric disorders. These include the color blind, who are unaware of their handicap or who have not learned to compensate for it, drivers with night blindness or with other defects in vision, those who have partial paralysis, poor coordination; epilepsy, heart disease, or other medical conditions subject to spells of fainting, dizziness, convulsion, or some type of unconscious spells. There are also the senile drivers, the feeble-minded, the mentally ill, the serious alcoholics, the immature and irresponsible or emotionally disturbed individuals, and others. Many of these individuals should be denied driving privileges. Medical and psychiatric examinations are necessary to discover the existence of such conditions and might play an important role in preventing accidents caused by these people.

"Our newspapers carry reports almost daily of serious accidents and traffic offenses committed by this type of person. Recently the Secretary of State of Illinois has recognized the problem of the older driver and is suggesting restricted or limited license provisions. Medical science has succeeded in lowering the death rate to such a degree that the average life span is steadily increasing. This indicates that more drivers in the advanced age group are to be expected and poses, in itself, a serious problem. Here is a group of citizens whose vision, hearing, coordination, alertness, memory, judgment and even muscular strength are likely to be failing, and it is a group of persons who often display emotional liability and lack insight into their own deficiencies. These factors and others would appear to make the use of medical and psychiatric facilities a real necessity in any modern traffic prevention program and indicate that such facilities will be a valuable adjunct to metropolitan traffic courts.

"If Chicago traffic courts are to adopt modern medical and psychiatric procedure, such procedures must be well planned and well conducted to be efficient. Such planning must take into account the legal status of referrals, proper criteria for referrals, prediction of case load based on the referral criteria, adequate space, staff, personnel, equipment, and necessary appropriations, and must include long range planning.

"Referrals by traffic court for such examinations may be pre-trial, post-conviction and pre-sentence, or referrals during a court continuance. In this matter, legal questions are involved which must be decided by the legal and judicial minds. Also, in this matter of referrals, some case load and economic considerations may arise since, for example, if only post-conviction referrals are made, there will be a limitation of case load which would probably be considerably less than if the basis were referral on a continuance date basis. From the psychiatrists' standpoint, there would appear to be little appreciable difference in the end results achieved, with the exception that experience has proved that the convicted person is more cooperative and does not as much tend to confuse the professional examination with his trial nor consider the examination something similar to evidence which may be used against him.

"In other words, the post-conviction referral produces less tendency to view

the examination as a procedure in which he is, somehow, forced to testify against himself or incriminate himself. In our studies of the traffic situation we have found that the tendency is to make referrals post-conviction only. Such is the case in Detroit traffic courts. A few other services are being requested by traffic courts such as examination of the individual whose license has been suspended when there are requests for restoration of the license before the original time set by the court.

"The criteria used by the judges for referral should be seriously considered, well established and adhered to consistently. Otherwise, in many instances, referrals will prove to be worthless to the court or may result in foregoing needed referrals. Also, if their criteria are not well established, a case load could result which could not be effectively handled by the psychiatric facility without unreasonable expenditures for space, staff, facilities and supplies.

"We recommend that the following criteria be established:

1. The complaint of the arresting officer or other complainant that the defendant behaved peculiarly or in a definitely unstable manner at the time of the offense or arrest.
2. Similar behavior to that described above occurring while in the custody of police or in the court room.
3. The presence of apparent physical handicaps which might be related to unsafe driving, or the offering of such handicaps, or an illness, as a defense.
4. A reported previous mental illness or mental deficiency.
5. The presence of alcoholism as an important factor in the offense.
6. Repeated serious offense or unusual length of an individual's traffic offense record.

"Adequate planning for these services requires the prediction of case load. The Detroit traffic courts use criteria similar to those recommended above. In recent years, their referral incidence is slightly over five per thousand cases from the so-called referral pool. This pool consists of cases actually heard by the judges and excludes all so-called cafeteria cases. In 1953, the total such pool in Detroit was 159,016. Corresponding figures from the Chicago traffic courts in 1953 show a referral pool of 853,260. Also, as mentioned above in this report, the Detroit courts referred only convicted cases.

"Assuming that the incidence of referral from Chicago courts would not be greater than that of Detroit, we might then predict that a psychiatric division of the traffic courts in this city would be called upon to perform over 4,200 examinations a year, at the present time. Such a referral incidence would almost double the present annual case load of the Psychiatric Institute and would equal approximately five times the case load of the corresponding Detroit Clinic. Such a predicted case load might require as many as twenty staff members, with corresponding need for space, equipment and supplies, especially if such a psychiatric division of the Psychiatric Institute were set up independent of the existing Institution, or as a branch of the present In-

stitute. The history of the new procedures of referrals to professional organizations connected with courts has been that the rate or incidence of referrals is built up slowly. A reasonable prediction based on past experience would be that in the first year of operation about half of the 4,200 referrals, mentioned above, would be maximum.

"The need for additional staff in the first year of operation of a traffic court clinic based upon the above predictions would realistically total thirteen to fifteen and would be composed of two clerks, one medical stenographer, three social service workers, four psychologists, two full time psychiatrists, (or four part-time psychiatrists) and one general physician. The general physician will be a very important part of the professional team because of the importance of physical conditions in the production of traffic offenses. He will need to be a well trained and experienced general practitioner able at the same time to perform basic routine laboratory tests and will assume the responsibility for physical examinations, diagnoses and recommendations with respect to physical conditions.

"At the present salary levels and present cost of supplies and maintenance, this would mean an additional budget for the first year of operation of $75,000, and require additional space of approximately ten offices plus a large testing room and additional space for files, supplies, additional waiting room space and bath facilities, and must take into account space needed for further expansion as the referral incidence increases in succeeding years. The matter of space and expansion for the Psychiatric Institute should be considered in relationship to the Institute as a whole and will be dealt with later in this report.

"Testing equipment is essential in a traffic clinic. We would suggest that in addition to the equipment needed for routine physical and emergency laboratory examination, the Psychiatric Institute obtain equipment for the following psychological tests:

1. Field of Vision
2. Color Vision
3. Distance Judgment
4. Visual Acuity
5. Reaction Time
6. Night Sight Vision
7. Hand Steadiness
8. Traffic Regulations Knowledge
9. Driving Judgment
10. Auditory Acuity

With the exception of equipment to test for acuteness of hearing, the traffic engineering and safety department of the American Automobile Association furnishes all necessary equipment for the above-listed tests. This equipment may be ordered through the local A.A.A. club. A single set of necessary testing equipment of all types based upon present day prices may be estimated to require an initial expenditure which will vary from $500 to $1,000, depending upon the elaborateness of the equipment and upon whether it is of the type which makes several tests possible, or separate items of equipment ordered for each individual test procedure. Multiple sets of equipment may of course

become necessary depending upon the number of referrals per day. Maintenance costs of such equipment should be very low since all of this equipment is operated on simple 110 volt A.C. current and is designed and constructed to give efficient and long time service. The cost of such maintenance should be included in the general expense appropriation for the Institute as are such maintenance costs pertaining to other mechanical equipment at the Institute.

"Previously in this report, the matter of additional space and physical facilities has been mentioned and the statement has been made that the subject of space should be seriously considered in relation to the Psychiatric Institute as a whole. I should like here to attempt such a consideration. The original quarters of the Psychiatric Institute at 1121 South State Street are now and have been, for a few years, woefully inadequate to care for the case load which is going through the Institute annually. Since 1948, a branch of the Institute known as the David B. Rotman Research Laboratory has been in operation in second floor quarters at the House of Correction.

"The major service which is rendered by the branch in the House of Correction has been that of caring for a case load overflow from the main Institute. This overflow has resulted almost entirely from the lack of adequate space to perform the examination at the State Street address and has proved to be an inefficient decentralization. The necessary travel time, duplication of administrative and supervisory efforts, et cetera, raises the cost to the City of Chicago per patient. It has also caused delays in examination, additional necessary reports of incompleted examinations, requests for additional continuances and, therefore, additional appearances before the court. If, now, the Institute is to take on the added responsibility of examining for the traffic courts, it would seem inadvisable to establish another branch of the Psychiatric Institute in the new traffic court building. To do so would only increase the cost per patient examined and make for further inefficiency. Also, as pointed out previously in this recommendation, it would require a larger staff per thousand referrals because of the inability to use to an effective degree team effort or group methods in which any of the existing staff at the Institute now at State Street or the House of Correction could participate.

"In the last few years, since the present plan of centralization of traffic courts was devised, there have been repeated discussions about turning over the remainder of the 10th floor at 1121 South State Street to the Psychiatric Institute. I am of the opinion that the Institute should be centralized as quickly as possible and that adequate remodeling of the remainder of the tenth floor would efficiently effect centralization, but that no smaller quarters will be adequate. It would seem advisable and efficient in operation, to maintain a single office in the traffic court building with at most two employees to effect direct liaison with the traffic courts, and to make direct contact with the referrals and secure their appointments at the Institute at State Street. The one or two employees functioning in such a manner in the traffic court building could, at any time the traffic courts are closed, return to the In-

stitute and join the working staff there for the remainder of their working day. Similarly, the essential service needed at the House of Correction is a screening service, to the superintendent and his staff, on prisoners serving sentences and on an occasional person detained on a court continuance who was not referred for psychiatric examination at the time of his court appearance.

"Since the House of Correction has a hospital division and a medical staff, the addition of a case work team composed of one social worker with psychiatric training, one psychologist, one psychiatrist and one medical stenographer to the hospital division of the House of Correction could take care of these needs. It is also entirely possible, in our experience with the present daily population of the House of Correction, that the services of all but the medical stenographer might be adequate on a half-time basis. If the Psychiatric Institute is centralized, and this screening service is to be a responsibility of the Institute to the House of Correction, it will, at most, require the services of the above four-person team for one-half of each day and will permit this team to join the general staff of the Institute for the remainder of the time. It is entirely conceivable that these necessary services may be rendered by additions to medical personnel of the House of Correction's hospital staff and the responsibilities for such services withdrawn from the duties of the Psychiatric Institute.

"This would be particularly feasible if provisions were made for a hospital type of detention facility which would permit the Psychiatric Institute to detain patients for repeated and intensive examinations and observation for a few days. Since, in some respects, when the Institute occupies space and renders service in the House of Correction, it appears to occupy the relationship of tenant to landlord, it may even be legally more correct to have the House of Correction assume its own responsibilities in this matter. In such event, this would enable the entire staff of the Psychiatric Institute to function together in the most efficient manner."

Conclusions

In 1948, Chicago people were aroused by the startling number of traffic fatalities—more than 500 a year. Mayor Martin H. Kennelly and the city council adopted a traffic enforcement program designed to reduce this problem materially. After extensive studies in Detroit, Los Angeles, and New York, the traffic court system of the Municipal Court of Chicago was revised to accommodate a potential case-load of two and one-half million traffic cases per year. The centralization and consolidation of traffic facilities, accompanied by expansion and intensified use of the Psychiatric Institute of the Municipal Court,

and by a continuing educational campaign for drivers and pedestrians such as that currently waged by the Court and the Citizen's Traffic Safety Board, should result in a model traffic center for the entire country.

In 1905, the founders of the Municipal Court of Chicago, then called dreamers and visionaries, established a flexible court, which, if properly supervised, could be adapted to meet any demands made upon it by the changing circumstances and rapidly increasing population of the great city of Chicago.

Driver License Action in New York

JAMES R. MACDUFF

Mr. Macduff in 1915 began work with the Schenevus National Bank, continuing with that institution until 1953. He served as assistant cashier, cashier, director and as vice-president. In 1953, the Schenevus Bank merged with the Wilber National Bank of Oneonta. Mr. Macduff was elected to the board of directors of the Wilbur National Bank of Oneonta and was made a vice-president. He has also conducted a general insurance agency for thirty-four years in Schenevus. He was a justice of the peace for twenty-eight years in Maryland, N. Y., was connected with the Board of Education for twenty-one years and was mayor of Schenevus village and a member of the Child Welfare Board of Otsego County for nine years.

IN NEW York State, the "point system" for dealing with habitual traffic violators began in its original form, almost at the Motor Vehicle Bureau's beginning, about 1925. It has, of course, been refined over the years. It works like this:

If a driver accumulates six points within two years, or eight points in four years, we call him in for a hearing. The usual result is suspension—sometimes revocation—of his license.

We count a conviction for speeding, or reckless or dangerous driving as two points. One-point violations include such offenses as passing a red light, running a stop-sign, crossing the double solid-line on the highway, passing a stopped school bus, improper lights, or failure to signal.

As to mechanics, the system puts the responsibility for detection of repeat violators on file clerks in our conviction files. When a conviction report comes to these files from the court, the filing clerk checks that driver's full record to see whether he has become subject to point procedures.

If so, the case is referred to the section that schedules hearings; the driver is summoned, his record reviewed by the referee. After hearing testimony the driver submits, the referee makes his decision —and depending on the record and the circumstances, he may recommend a suspension for thirty days, or sixty, or ninety, or more. Or, he may revoke the license outright.

Last year, there were 2,758 suspensions and 512 revocations under the system—both totals representing new highs in the history of the bureau. In fact, our suspensions and revocations of repeat violators have increased steadily, year after year.

Actually, some repeat violators are suspended or revoked under specific statutes, unrelated to the point system. The point system is not a program set up by law but a matter of regulation and procedure in New York. Thus, the 3,270 licenses suspended or revoked under the point system in New York last year do not reflect all license actions against what might be characterized as chronic violators.

Both Law and Point System Applied

Altogether, license revocations and suspensions for all causes in New York last year reached a record high of 161,631.

Chronic violators have always presented a troublesome problem. We strongly believe that disrespect of law breeds further lawlessness and carelessness on the highways, and that the lawless operator is first and foremost a dangerous operator.

We are trying hard to cope with that kind of individual in New York, both by law and by point system procedures. And it may well be that we will have to make them even tougher in their application if we are to either cure or put out of driver-circulation those who just won't conform to a reasonable pattern of highway behavior.

While a large part of the function of license revocation and suspension lies in the realm of judicial or administrative judgment, there are certain grounds under which revocation of the license is mandatory under New York law.

The license must be revoked after conviction of any of the following: driving while intoxicated, homicide or assault arising out of the operation of a motor vehicle or motorcycle, criminal negligence resulting in death, or leaving the scene of an accident. Revocation is also mandatory for three convictions in eighteen months for (1) speeding, (2) reckless driving, or (3) any other traffic misdemeanor, regardless of whether the three convictions are for the same or different offenses. A false statement in applying for a license or registration, or a substitution in an examination, is another ground for mandatory revocation.

A great many circumstances, of course, authorize revocation of a license. But where revocation or suspension is permitted, the law specifies that the individual have an opportunity to be heard—except in cases where the revocation or suspension is based solely on a court conviction or convictions, or on a court commitment to an institution under the jurisdiction of the state department of mental hygiene. In any event, a license or registration may be temporarily suspended without notice, pending prosecution or a hearing before one of our eighteen motor vehicle referees.

There are a number of situations under which the bureau institutes immediate action under permissive provisions of the law upon receipt of a conviction report. When we receive a report of conviction of an unlicensed operator, we immediately suspend any registrations of the individual until a license is obtained. When a junior driver is convicted of misuse of a junior operator's license, we suspend the license pending a hearing. This same action follows when we receive a conviction report showing that the holder of a junior license has been guilty of speeding or reckless driving.

We revoke the license in most cases where an operator has been convicted of reckless driving reduced from an initial charge of driving while intoxicated. We also revoke the license in cases where there is a conviction for reckless driving following a personal injury accident. And we suspend registration plates, pending a hearing, when an individual is convicted of driving while license is suspended or revoked.

Suspensions Effective Immediately

Suspensions may range from a few days up to several months, depending upon the individual offense and the circumstances surrounding it. In many cases, suspension is for an indefinite period because restoration of the license is contingent upon the meeting of certain specific requirements of the law—such as in the case of financial responsibility suspensions.

When a license is suspended, a suspension order is issued by the bureau and sent to the individual—effective immediately. If the suspension is for a definite period of time, such as thirty days, the suspension period begins to run from the time the operator surrenders his license. Where the suspension is made by the bureau, the in-

dividual is told on the suspension order where to surrender the license—usually at the district office nearest his home.

Where the suspension is made by some official outside the bureau, such as a judge, the license is sometimes picked up immediately and forwarded to the bureau with the conviction report. In these cases, the period of suspension begins to run at the time the license is seized by the local official.

As you can see, our license suspension and revocation operations are geared closely to the filing of conviction reports by the courts throughout the state. As the conviction certificates are received, they go to our safety section to be sorted and classified. In cases where license action is mandatory, or where for other reasons immediate action is indicated, this section immediately issues the suspension or revocation orders. The remaining conviction reports are then filed, but in this filing process the previous record of the individual driver is examined and his past record of convictions reviewed.

This review forms the basis for the administration of our point system for nailing habitual violators.

Our point system is based on a provision of the law that authorizes suspension or revocation on a permissive basis "for habitual or persistent violation of any of the provisions" of the vehicle and traffic law, "or of any lawful ordinance, rule or regulation made by local authorities in relation to traffic."

In New York, only the motor vehicle commissioner can restore a suspended license or approve a new application after a license is revoked. In the matter of suspensions, there are relatively few complications. In fact, when a license has been suspended, it is automatically restored to the individual at the end of the suspension period if it was initially suspended for a definite term. Likewise, where the suspension is made pending compliance with specific provisions of the law, such as under financial responsibility, the suspended license is returned automatically when the conditions have been fully met.

New License After Revocation

In the matter of revocations, the story is of course entirely different. Once a license has been revoked, it cannot be restored. However,

the individual may be permitted to make application for a new license, in which event he is obliged to take the full driver examination and qualify for his new license.

Treatment of new applications, following revocation, depends to a very large extent on the circumstances in each individual case. If it was revoked mandatorily, as for driving while intoxicated, the law provides that at least six months must elapse before a new license is issued—and it provides further that no new license may be issued thereafter except in the discretion of the commissioner of motor vehicles. Furthermore, the law specifies that no new license may ever be issued to a person who has been twice convicted of driving while intoxicated where personal injuries have resulted in each instance.

Under the bureau's current procedures, where a license has been mandatorily revoked, the individual is permitted to file a new license application at the end of six months. If he has no other record, and there is no reason to believe that he may be a poor driving risk, his application will ordinarily be approved and he will be permitted to take the driver's license tests provided he has submitted required letters of recommendation.

If the applicant lives in the metropolitan New York area, he must submit letters of recommendation from two of the following: his employer, his clergyman, or a reputable businessman. If he lives outside of the metropolitan New York area, he must submit a letter of recommendation from the chief of police of his community together with letters of recommendation from any two of the following: his employer, a reputable businessman, the police justice or city judge of his community, the district attorney, the sheriff, or a justice of the peace.

However, if we find on review that the individual has a bad driving record beyond the cause of the mandatory revocation, or if there are any other circumstances in his file which give the commissioner grounds for exercising his statutory discretion to refuse the application, the individual may have to wait another six months before his new application will be accepted. Or, if his past record is extremely bad, the chances are that he may never be permitted to have a license again.

Where the revocation of a license is permissive, the law provides that no new license shall be issued until after thirty days of the

revocation—nor thereafter except in the discretion of the commissioner. Thus, an individual whose license has been revoked permissively may file a new application thirty days later. Approval or denial will depend upon the applicant's record.

If there is nothing in the record to indicate that it would be unwise to accept the application immediately, the individual is given an opportunity to take the driver's examination again at the earliest possible time. However, if the individual's record is unfavorable, under our discretionary authority we may refuse to accept his application until further time has elapsed, or we may never approve. In the case of permissive revocations, the individual is not required to submit letters of recommendation—but unless his record is clean, he may hardly expect favorable action at the end of the 30-day period.

In reviewing the records of all of these drivers, our safety section pays special attention to individuals who have either habits or physical afflictions which may cause them to be poor risks on the highway. Our reviewers are on the lookout for individuals afflicted with epilepsy; those who are known to be alcoholics, and those who use narcotics. Whenever a physical or mental disability is indicated in the application or in the driver's record there is a thorough investigation. Ordinarily there is considerable correspondence with physicians, psychiatrists and heads of hospitals to ascertain the facts.

In the same manner, a vast amount of attention is paid to individuals who have been convicted of serious crimes. A felon is not granted a license unless our investigation discloses that he has definite and real need of a license and is actually endeavoring to rehabilitate himself. In such cases, we obtain the full facts concerning the applicant from the New York Parole Division, the State Correction Department, the U. S. Probation Department and local law enforcement agencies. In some cases, special investigations are conducted by the State Police. This unit of our safety section conducts upwards of 20,000 investigations during the course of a single year.

In New York, we regard the license revocation function as an invaluable weapon in the fight for accident reduction. In applying provisions of our law which penalize lawless drivers, I believe we are making definite headway toward the goal—to make motoring in New York pleasanter, more efficient and, above all, safer for everyone.

Milwaukee's Parking Problem

FRANK P. ZEIDLER

Mr. Zeidler has been Mayor of Milwaukee since 1948. A practicing engineer, he engaged in large-scale suburban redevelopment, and in city planning, housing, and traffic improvements. He has twice represented the United States Conference of Mayors at the Canadian Conference and was the author of a public works plan for cities adopted by the Canadian Conference. In 1953, he was a member of the U.S. National Commission for UNESCO, and in 1954 a member of the Special Committee on Non-military Defense Planning. For the following article, Mayor Zeidler acknowledges his deep indebtedness to Mr. Howard Ilgner, Traffic Engineer of Milwaukee, for assistance in the preparation.

INSTEAD of using public transit carrying some fifty persons per vehicle and requiring no terminal facilities enroute, many Milwaukeeans— in fact, most Milwaukeeans—prefer to use private automobiles carrying on the average of only one and six-tenths persons per vehicle, requiring parking space whenever occupants of the vehicles wish to stop for work, shopping, amusement, business, visiting, or schools—plus storage space during non-use

Even stopping to load or unload materials at the curb, taking on or leaving off passengers obstructs moving traffic. On many main through-trafficways or sections thereof, parking is not only prohibited at all times, but there is an increasing tendency to prohibit even standing or stopping during rush hours. Expressways prohibit all three at all times. Yet without these privileges, the advantages of the automobile to abutting properties, especially business properties, are greatly reduced and such regulations are often considered detrimental. Consequently, the providing of terminal facilities or parking has become an important part of the traffic problem and a governmental responsibility.

A moving car cannot use the space occupied by a parked car. Also, roadways cannot be plowed clear of snow or the snow removed if they are parked solid with automobiles, nor can they be properly cleaned of refuse or debris. Milwaukee, in the snow belt, has had more than ninety inches of snow a year, but modern cities even in the

snow belt cannot afford to have limited roadway travel capacity in the winter months. To maintain the maximum capacity, streets must be cleared of snow rapidly and thoroughly. Snow storms are apt to come at the most inopportune times without advance notice and frequently do just that. The City of Milwaukee tries to have the roadways of all streets plowed by morning of the day following a snowfall.

The consideration of parking in Milwaukee may in general be divided into four classes: 1. residential areas; 2. central business areas; 3. outlying business areas; and 4. industrial areas. The city's interest in parking from a governmental standpoint may in general be summed up as follows: 1. overall restricted or controlled night parking makes for better law enforcement; 2. overall controlled night parking is necessary for snow plowing and removal purposes; 3. overall controlled night parking is necessary for proper street cleaning; and 4. "No Parking" restrictions at many special locations and on many traffic streets are necessary in order to provide additional traffic lanes to facilitate traffic flow, either at all times or at certain times. Also: 5. Unrestricted and even limited parking in many instances makes access impossible to many business establishments and private homes without double parking, thus causing traffic bottlenecks. 6. Many existing business districts need parking in order to continue as such, but are unable to provide off-street parking, and the city on the other hand, cannot afford to lose these businesses.

In Self-Defense

In self-defense, therefore, the city finds itself active in the parking problem to preserve itself as an active going concern. Milwaukee has a population of approximately 672,000, a motor vehicle registration of 212,000, an area of 63 square miles, and a suburban population of 244,000.

In general the street parking regulations in Milwaukee are probably like those of almost any other city. There is time-limit parking on most business streets and in industrial plant areas. There are "No Parking At Any Time" restrictions on the city's main downtown thoroughfare, on one side of narrow roadways, and at strategic traffic locations. There are also "No Parking" restrictions on many traffic arteries during the morning peak traffic period between 7 and 9 A.M. and during the evening peak period between 3 and 6 P.M.

There is metered parking both in the central business area and in the outlying business areas, with 4300 parking meters in operation.

The first parking meters were installed in December, 1949, and the total gross revenue from the parking meters since that time is $1,324,375 up to July 1st, 1954. The average gross income per month is approximately $38,000.

All parking meter revenues, less cost of installation, maintenance and operation, were originally put in a separate fund earmarked for off-street parking purposes. This method of financing, however, has been attacked in a taxpayer's suit, and a definite budget appropriation equal to the estimated income from the parking meters is now made to provide for parking meter collections, parking meter installations, and parking meter operation and maintenance purposes and the balance of the estimated income is set up for the purchase and development of off-street parking facilities.

Actually thus far the taxpayer's suit has not made any difference in the parking funds, but has delayed purchase and development of off-street parking. Whether there is a continuing separate fund earmarked for parking meters and off-street parking purposes, or whether the amounts are budgeted, is not important so long as an amount equivalent to the income is budgeted for parking meter and off-street parking expenditures.

The All-Night Parking Problem

Previous to the winter of 1950–1951 an all-night parking ordinance prohibited any vehicle of any kind or description from being parked on any public highway of Milwaukee between the hours of 2 and 6 A.M. for longer than two hours, unless other ordinances providing more restrictive parking as to place or time would be violated. Any departure from this regulation required permission from the police department.

As the number of automobiles increased, with the consequent shortage of garage or other off-street parking facilities, the police department telephone lines became deluged with telephone calls requesting permission to park all night along the street curbs. So great did the number of calls become, especially on weekends when there were many visitors in the city, that important calls relating to crimes and accidents could not get through without serious delay.

The parking of these additional automobiles on the roadways at night in the winter also interfered with snow plowing and snow removal, and at other times with the proper cleaning of the roadways. This led to the adoption of a new all-night parking ordinance that provided special regulations for winter months. Essential parts of the general overall features of this ordinance follow:

"(a) (1) *All-Night Parking Prohibited.* No person, firm, partnership, or corporation, nor any officer, member, agent, servant, or employe of any firm, partnership or corporation shall suffer any vehicle of any kind or description to be parked on any public highway of the City of Milwaukee between the hours of 2:00 A.M. and 6:00 A.M., except that:

"(A) From the 16th day of April to the 15th day of November, inclusive, of any year, vehicles may be parked for a period of not longer than two (2) hours, provided that no other ordinance restricting parking as to place or time is violated thereby.

"(B) From the 16th day of November to the 15th day of April, inclusive, of the year following, upon any arterial highway or upon any street upon which there is operated a trackless trolley, motor bus, or streetcar line vehicles may be parked until 3:00 A.M.; provided that thereafter they may only be parked for a period of time not longer than three (3) minutes for actual loading or unloading of passengers or thirty (30) minutes for actual loading or unloading of property, provided that no other ordinance restricting parking as to place or time is violated thereby.

"(C) From the 16th day of November to the 15th day of April, inclusive, of the year following, on streets other than arterial highways or those upon which there is operated a trackless trolley, motor bus, or streetcar line vehicles may be parked for a period of not longer than two (2) hours, provided that no other ordinance restricting parking as to place or time is violated thereby.

This, however, did not take care of those who had no off-street parking facilities. For those operators, additional sections providing special privilege permits were added. The essential items covering this matter follow:

"(D) In congested areas, as designated by the Police Department, vehicles may be parked during such hours, provided they shall first obtain a special privilege permit from the Police Department after filing an application with said department and paying a permit fee to the Police Department, all as required under this ordinance and shall be parked as authorized by such permit.

"(E) Any vehicles parked pursuant to the provisions of subsections (A) through (D) above shall be parked only on the even numbered side of the street on those nights bearing an even calendar date during the portion there-

Typical Off-Street Parking Lot in Outlying Business Area in Rear of Business Development.

Typical Off-Street Parking Lot in Congested Residential Area Without Adequate Garage Facilities.

of before midnight, and on the odd numbered side of the street on those nights bearing an odd calendar date during the portion thereof before midnight, except that where parking is normally being permitted only on one side of the street, vehicles parked pursuant to aforesaid provisions may be parked on that side of the street only, on every night of the week.

"(2) Motor trucks, motor buses, motorcycles, motor delivery wagons, trailers, semi-trailers, cabin trailers and tractors shall not be eligible for such special privilege parking permits.

"(b) (1) The application form shall contain the name and address of the owner of the vehicle, the license number, make and year of the vehicle, the name of the month of issuance, and the date of expiration, a statement that the owner resides in the designated congested area and is unable to find reasonable accommodations.

"(2) The permit shall contain the number of the permit, the name and address of the owner of the vehicle, the make, year, and license number of the vehicle, the location where the vehicle is to be parked, the month of issue, and date of expiration. The permit shall be a different color every month. All permits shall be numbered consecutively."

"(c) The application for a special privilege permit shall be first approved by the Police Department in accordance with the needs of the individual in said congested areas before a special privilege permit can be issued by said department, and said permit shall be valid for a period of not longer than one month ending at midnight of the last day of the month of issue. The Police Department may revoke said permit if at any time reasonable accommodations are available to the owner.

"(d) The permit shall be placed in the lower right hand corner of the windshield or in such other conspicuous place as the Police Department may designate, while the motor vehicle is in a parked position.

"(h) From the 16th day of November to the 15th day of April, inclusive, of the year following, no special privilege permits shall be issued for parking upon any arterial highway or upon any street upon which there is operated a trackless trolley, motor bus, or streetcar line. On all other streets parking permits shall be issued subject to the condition that the permitee shall park only on the even numbered side of the street on those nights bearing an even calendar date during the portion thereof before midnight, and on the odd numbered side of the street on those nights bearing an odd calendar date during the portion thereof before midnight, except that where parking is normally being permitted only on one side of the street, parking permits shall be issued subject to the condition that vehicles shall be parked on that side of the street only, on every night of the week."

In fairness to people who had provided off-street parking space at a cost to themselves or those who were intending to provide such off-street parking space, it was decided to charge a fee as follows:

"(e) The special privilege permit fee shall be $4.00 per month; provided, however, that if any permit is granted after the 15th day of the month, the permit fee shall be $2.00 for the remainder of said month."

The plan to issue permits greatly simplified the enforcement problem in the matter of night parking, relieved the police telephone situation, and improved conditions for snow plowing, snow removal, and street cleaning. It was, however, the thought of the Milwaukee group who sponsored these ordinances that efforts should also be directed toward a solution to the problem rather than just providing relief, and it was further provided that the permit fees obtained for these special parking privileges be handled in accordance with the following paragraph:

"(f) All moneys received from said permit fees shall be placed in a separate fund for off-street parking purposes only, except that costs for the printing of application forms and permits, stationery, postage, office supplies, and for any other kindred forms and the printing thereof in connection with the administration of this ordinance shall be paid out of this fund."

This provision has been faithfully carried out and money is now on hand to provide off-street parking in residential areas where the lack of parking and garage facilities is the greatest and where improvement by private enterprises is difficult—in some cases, practically impossible—without undue destruction of property.

The all-night $4 a month parking permits have been in effect since May of 1950, with an average of approximately 7,000 full-month permits issued each month. The gross income from these parking permits since their inauguration has been $1,301,380 up to July 1 and the present average gross income a month is approximately $30,000.

Revenue from All-Night Parking

All-night parking permits have been attacked in a taxpayer's suit, holding up the immediate use of these funds for off-street parking purposes. However, the revenue from all-night parking permits is now considered as general revenue of the city, and as in the parking meter revenue, an amount equivalent to the income from the permit fees, is budgeted for off-street parking purposes. The decision

of the Circuit Court before which the case was tried is of great interest and importance. The court concluded that the defendant—City of Milwaukee—may properly plan and develop a program intended to relieve the critical problem of congestion of automotive traffic upon the streets of the city and to provide for off-street parking of automobiles in areas of concentrated commercial activity.

It is considered that to promote and accomplish this result, the city was acting under its police power, and that revenues from the parking meter fund and the so-called special privilege parking fund, which are included in the budget for 1954 under the Charter Ordinance amendment may properly be applied to the purchase, development, and operation or maintenance of off-street parking facilities.

It was held that the city had authority to acquire lands to be used for the construction of municipal parking facilities, as well as the issuance of revenue bonds or mortgage bonds therefor. Authority was also provided for the payment of principal and interest of such bonds out of parking revenues.

It was further stated that the attack made by the plaintiff upon the so-called special privilege parking permits issued by Milwaukee to residents of congested areas without adequate garage facilities, which permits allow parking of automobiles on certain public streets during limited hours of the night-time, is considered to be without merit. The issuance and use of such permits relax the complete prohibition of night parking in other sections of the city. It is pointed out that by 1949 the enormous increase in automobile registrations in the City of Milwaukee and the subsequent need for places to store such vehicles overnight created a problem for residents who were automobile owners. There were not enough night-time off-street parking spaces in existence in areas of high population concentration, such as apartment and rooming house areas, to park all vehicles owned by such residents of these areas at night.

To relieve the condition, Milwaukee's Common Council determined to allow limited night parking on the streets rather than to repeal the ordinance prohibiting all-night parking. The court ruled that the issuance of special-privilege parking permits and the ordinance permitting them were reasonable police regulations of the use of the streets. Cases relied upon by the plaintiff were distinguishable

from the case at bar in that obstructions or permissive use of the streets which are of a permanent character and not merely temporary are obviously condemned. However, the ordinance permitting residents to park their automobiles within reasonable proximity to their homes under permits reviewed at stated intervals—permits not permanent—must be considered a reasonable exercise of police power.

The court further held that the projects for off-street parking involve a public purpose and a public use, and that therefore the revenue and its expenditure were authorized for the police. The defendant city in this program, seeking to relieve a problem confronting all large metropolitan communities, was realistic in holding that it affected the whole public.

The court held that the action taken and contemplated was authorized by the statutes of Wisconsin and that objections to the program and to specific instances of the acquiring of off-street parking areas included in the amended complaint filed must be overruled.

While this verdict takes care of this matter for the present, it appears that it will be appealed to the Supreme Court. In the meantime the City of Milwaukee is continuing the use of parking meters and the issuance of parking permits for all-night parking—the gross amounts of revenue being made available for installing and operating parking meter and for acquiring and developing off-street parking sites.

Ten Off-Street Parking Principles

All this, however, in no way makes possible the establishment of parking lots promiscuously and making a public "grab bag" of these funds. A carefully studied plan adopted by the Common Council of the City of Milwaukee, taking care of the situation, is known as the Ten Off-Street Parking Principles. Items of particular interest follow:

1. Whenever and wherever possible, private businessmen will be encouraged to create and to operate parking facilities entirely with their own capital. In cases where such businessmen are unable to buy the desired land at a fair price, the city may acquire the land and lease it to them for an annual rental sufficient to cover all costs incurred by the city.

2. As a matter of general policy, the Common Council will not appropriate in any one year more money for the purchase, construction, and maintenance of off-street parking facilities and on-street parking meters than an

amount equal to the actual and estimated revenue from all on-street and off-street parking revenue sources plus any estimated accumulated surplus of previous parking revenues over prior expenses for such purposes.

3. It will be a matter of policy that the Common Council will not consider any requests for off-street parking facilities unless the merchants and property owners in the area concerned agree to having parking meters installed on the business streets involved. If possible, such meters should be installed well in advance of the time when land is to be acquired for the proposed lot or structure.

4. A charge will be made for parking on all municipally sponsored lots so that a revenue will be yielded. Revenues will be obtainted in one of the following ways:

(a) By installing parking meters;

(b) By leasing the facility to a private operator who in turn will collect parking fees; or

(c) By hiring city attendants to collect fees (can only be legally used in cases where suitable lease cannot be negotiated.)

5. Revenues from the off-street facilities and the street meters in each area will be used to cover operating and replacement costs and as large a percentage of land acquisition and improvement costs as possible.

6. The portion of land acquisition and improvement costs that cannot be financed from the above-described revenues will be covered from benefit assessments on nearby properties that are zoned for business if corresponding benefits are created.

7. No municipally sponsored business area parking lot will be installed unless it can be expected that all costs can be paid from the revenues and benefit assessments collected in that business area.

8. In so far as it is practical and within legal limits prescribed by applicable statutes, charter ordinances, and ordinances of the city, consideration shall be given to a plan of reflecting costs for the acquisition and construction of off-street parking lots so that in determining the benefits to the various business properties the estimated amount which would be derived from parking revenues accruing from the lots and on the streets in the area in which such lots are located in a fifteen-year period can be offset against the total cost of the acquisition and construction of such lots, such differences to be considered the direct benefit to such business properties."

How Off-Street Parking Program is Organized

Development of the off-street parking program is under the guidance of the Milwaukee Parking Commission, an advisory body of nine members. Six are citizen members, the other three are members

of the traffic engineering staff, city attorney staff, and the city planning staff. Recommendations are made by this body to the common council after careful survey and study.

The actual work related to the development and operation of the off-street parking facilities is performed through the regularly established city departments usually responsible for the various branches of activity involved. This is as follows:

1. Surveys—	Department of Public Works
2. Legal Services	City Attorney
3. Financial Services	City Comptroller
4. Assessments	Board of Assessments
5. Details of Plan—	Department of Public Works—review by Board of Public Land Commissioners and the Parking Commission
6. Letting contracts, inspection or construction by direct labor force—	Department of Public Works
7. Maintenance – Repair surface, mark stalls, maintain parking meters, maintain lights, housekeeping, snow removal, care of trees and shrubs, rubbish removal	Department of Public Works
8. Leasing of city-owned parking lots and leases affecting parking properties—	Parking Commission and Board of Public Land Commissioners (Real Estate Division)
9. Collection of rents, if any—	Board of Public Land Commissioners (Real Estate Division)
10. Modification of plans—	
a. affecting private property	Board of Public Land Commissioners
b. within lot	Commissioner of Public Works, with Parking Commission
11. Rights of abutting property owners for ingress, egress, loading or unloading	Commissioner of Public Works, with Board of Public Land Commissioners and City Attorney
12. Collection of coins from parking meters	Same collector who collects from meters on the streets.

The traffic engineer and his staff, a division of the Department of Public Works, are coordinators of the off-street parking activities

inasmuch as parking is a part of the integrated traffic and public transit operations problem.

The general status of off-street parking facilities within the city limits is indicated by the following tabulation:

ESTIMATED OFF-STREET PARKING
CITY OF MILWAUKEE
(Does not include private storage facilities)

OWNERSHIP	DEVELOPMENT	OPERATION	NUMBER OF SPACES
City	Temporary	Lease	3,182
City	Permanent	Lease	343
City	Permanent	City	108
Private Operator	Temporary and Permanent	Private	13,000
Retail Establishment	Temporary and Permanent	Private	10,000
Industrial Plants	Temporary and Permanent	Private	14,200

In the matter of parking in industrial areas, the city has not provided any off-street parking facilities inasmuch as no parking funds are usually derived from the area. The city, however, is very much interested in curb parking regulation in industrial areas and areas adjacent thereto. In a number of instances where parking lots are provided for all-night parking in residential areas, these facilities will also be available for daytime all-day parking.

The city's financial interest in providing off-street parking facilities of a permanent nature will total to one thousand seven hundred thirty-one (1,731) parking spaces through 1955 and may be summarized as follows:

	NUMBER OF SPACES
Land acquisition and development complete	303
Land acquired—development in progress	172
Funds set up—land being acquired	159
Funds set up—legal processes under way	789
Preliminary studies completed	308

Funds proposed for 1955—$1,628,000

To help further relieve the parking problem, the city also has a zoning ordinance which requires off-street parking spaces for the fol-

lowing types of buildings or structures which are either erected or enlarged:

1. One-family and multiple-family dwellings
2. Public housing projects for low income families
3. Rooming or boarding houses
4. Hospitals or sanitariums
5. Transient hotels in residence districts only

Thus far no funds have been set up for off-street parking purposes from city taxes or income other than that derived from parking meters and special privilege parking permits, and it is possible that the entire cost of development and operation can be carried by income derived from the motor car owners and users on an equitable basis and without undue hardship.

The Mackinac Bridge

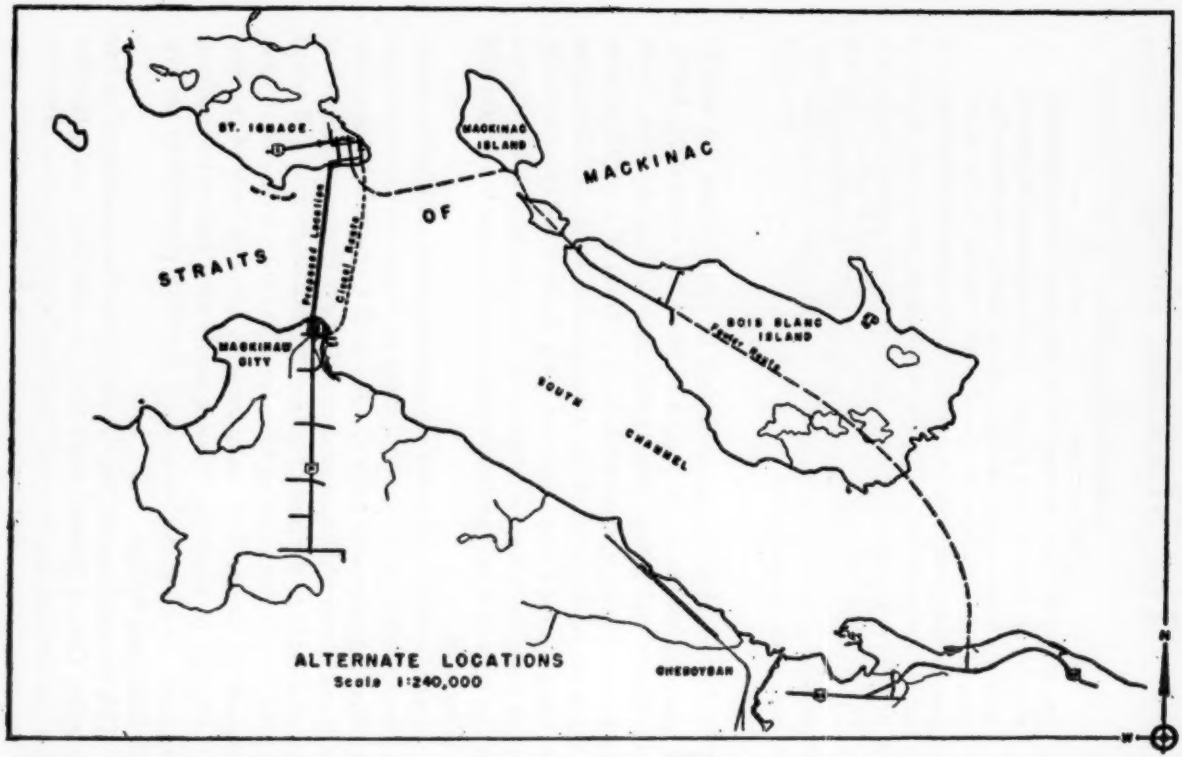
LAWRENCE A. RUBIN

Mr. Rubin has been secretary of the Mackinac Bridge Authority since its creation in June of 1950. At the same time he was executive director of the Michigan Good Roads Federation. Previously, he was assistant director of public relations for the Michigan State Highway Department. Since 1952, when the Mackinac Bridge Authority was enabled by legislation to finance and build a bridge across the Straits, Mr. Rubin has been engaged in the battle to raise nearly $100,000,000 required for the structure, the largest loan ever floated for such a purpose. Now that the structure is under way, he is the Authority's executive officer in its guidance of the entire project.

TWO historical events combined to bring about the world's greatest bridge at the Straits of Mackinac connecting Michigan's Upper and Lower Peninsulas, thus uniting the state. First, about 12,000 years ago nature decided to drain off a huge land mass in the north-central area of the American continent, and the region now known as the Great Lakes was born. Second, and more recently, several politicians made a decision in 1837 granting to Michigan a portion of land which geographically is much more firmly attached to Wisconsin.

Now, men and equipment are matching their skill and resources to connect Michigan's two land areas by a steel and concrete span over the four-mile-wide body of water with Upper Michigan on the north and Lower Michigan on the south, Lake Huron to the east and Lake Michigan to the west. A glance at a Michigan map will reveal that the Upper Peninsula of Michigan, 300 miles from east to west, comes closest to, but does not quite join, the main body of the state at the Straits of Mackinac. Consequently what nature left undone, man must complete. A connecting link will be provided by the five-mile Mackinac Bridge.

This accomplishment has for many years been hindered by two obstacles: One, a channel more than 200 feet deep and 3,600 feet wide cuts through the Straits of Mackinac requiring a structure with a center span 3,800 feet long, second only to the Golden Gate's 4,200



Map shows the location of Mackinac Bridge and alternate routes proposed during the last thirty years. The one entitled "Proposed Location" is the route of the Mackinac Bridge.

feet. The other, political promises to connect the two peninsulas, made so often and with such regularity that many people placed more faith in the recurrence of the pledges than in the actual commencement of construction. Thus the bridge came to be what is commonly known as a "political football."

However, vastly expanded use of the automobile, good roads, and the recreational advantages of Michigan's Upper Peninsula have all combined to induce millions of people to cross the Straits every year. The State Highway Department, in an effort to accommodate the soaring post-war demands for Straits crossings, added a boat and new dock facilities to the thirty-year-old ferry service; but the better the service, the heavier the traffic.

Bridge Authority Studies Feasibility

Spurred on by a citizen's committee for a bridge, the state legislature in 1950 created an authority with power to determine the physical and financial feasibility of a connecting link. The governor appointed a commission comprised of prominent Michigan citizens to serve without pay. The Authority, within thirty days after its organization, retained the services of the nation's three leading long-span bridge engineers and a firm of traffic analysts to submit a report on the potential earnings of a bridge across the Straits. Six months later, in January, 1951, the Authority made a preliminary report to the legislature that the structure was physically and financially feasible.

The engineers agreed that a four-lane bridge with a 3,800 foot center span would cost $76,000,000. The cost of financing was estimated at about $11,000,000. According to the traffic analysts, 600,000 vehicles crossed the Straits on the ferry service in 1950. It was estimated that crossings would increase at the rate of 6 percent a year until the structure was completed, and that it would induce an increase of 125 percent in traffic during its first year of operation. The traffic analysts also stated that the bridge was financeable, but that it would be advisable for its operation and maintenance costs to be paid out of state highway funds, since that agency was expending about one-half million dollars a year to subsidize the ferry service.

Because of the Korean war with accompanying shortages of men

and materials the Authority did not request permission from the 1951 legislature to finance and build the structure. A year later in the spring of 1952, such legislation was requested and passed. The Authority immediately filed an application with the Reconstruction Finance Corporation requesting that agency to purchase $85,000,000 worth of its bonds.

While the RFC was investigating the application, traffic at the Straits was increasing at a rate far greater than that predicted by the traffic analysts. Instead of 6 percent a year in 1951 and 1952, the trend was better than 15 percent a year. This encouraged private investment bond bankers to become interested in the project, and the Authority requested the RFC to hold its application in abeyance.

In November, 1952 the Authority entered into an agreement with a leading New York revenue bond underwriter to manage the bridge financing, selected a designing engineer, and recommended a San Francisco consulting engineer. Tentative contracts contingent upon successful financing were entered into for the substructure and the superstructure. All the necessary legal and financing documents were prepared and the Authority was ready to market its bonds in late March, 1953. By that time, the money market which had been tightening up steadily since the first of the year was unable to absorb the $96,000,000 bridge revenue bond issue and financing was postponed.

Marketing the Bonds

To make the bonds more attractive, the Authority requested the legislature to provide for the cost of operating and maintaining the structure out of state highway department funds. In May, 1953 an act was passed appropriating $417,000 a year for that purpose, if and when the structure was opened to traffic. The legislature put a time limit on this offer so that unless the bonds were sold by December 31, 1953, the $417,000 would be withdrawn.

Another effort was planned for June, 1953, and it likewise was called off because of bond market conditions. The summer months saw no improvement in financial circles and it was not until mid-autumn that some encouragement appeared. While the Authority was working full time to interest insurance companies in financing the structure on a draw-down basis, similar to the New Jersey Turn-

pike financing, a New York investment banker proposed a novel plan for financing the structure.

He suggested two series of bonds with first and second liens on revenues. It was a race against time to complete all of the financing and legal documents and arrangements so that the sale could be consummated before December 31, 1953. But this objective was finally accomplished when the Administrative Board of the State of Michigan approved the sale of all the bonds on December 17. They consisted of $20,000,000 worth of 5¼ percent bonds and $79,800,000 worth of 4 percent bonds, the latter having a first call on the bridge revenues. The bonds were delivered to and a check for $96,000,000 received from the underwriters on February 17, 1954. On the same date, the contracting firms for the substructure and superstructure were given letters to proceed with the construction.

Induced Traffic Estimate Revised

It should be pointed out that the substructure contract is for a lump sum. It has no provision for escalation of any items of cost including labor, materials or quantities. The amount of the contract is $25,735,600 and covers the construction of thirty-three marine foundations. The contract for the superstructure is in the amount of $44,532,900. It protects the Authority against escalation of wage and material prices, but not quantities, which on the superstructure can be fairly well estimated.

Additional contracts will be let for paving, approaches, administration building, toll gates, and electrical equipment. These amount to approximately $5,500,000. The cost of engineering is $3,500,000, bringing the total construction cost to $79,274,250. Real estate, preliminary expenses, and administration amount to $800,000.

In completing the final report for financing purposes, the traffic engineers took another look at their induced traffic estimate. Nearly three years had elapsed since these engineers had made their original prediction of 125 percent induced traffic. They deemed it advisable to reduce this figure to the far side of conservatism for two reasons. First, the new $5,000,000 ferry boat had increased the capacity for ferrying vehicles across the Straits by one-third; second, instead of 710,000 vehicles crossing the Straits in 1953 as predicted, that year

saw more than 900,000 vehicles carried between the two peninsulas. Thus, the final report estimated induced traffic at 75 percent.

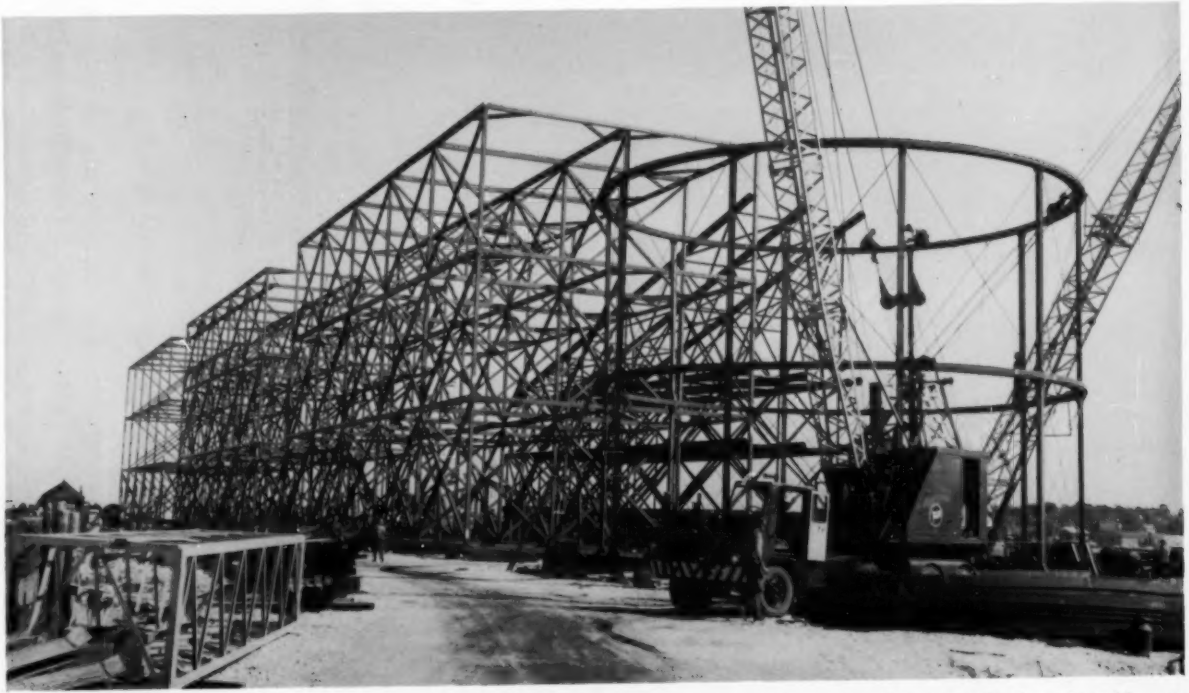
In designing the structure, special consideration was given to the extreme weather conditions characteristic of the Straits area. The Straits freezes over every winter. Consequently, the bridge foundations are designed to withstand five times the highest recorded known pressure of ice. A wind velocity of 78 miles an hour is the highest ever measured at the Straits. Therefore the superstructure is designed to provide aerodynamic stability against wind pressures of 120 miles an hour. Other physical features such as the rock foundations underlying the Straits and the deep water currents have been probed, measured, bored, and studied.

The following statistics list the proportions of the structure:

Length of Suspension Bridge (including anchorages)	8,614 feet
Length of Main Span	3,800 feet
Total length of Steel Superstructure	17,918 feet
Length of North Approach (including mole)	7,791 feet
Length of South Approach	486 feet
Total length of Bridge and Approaches	26,195 feet
Height of Main Towers above water	552 feet
Depth of Tower Piers below water	200 feet
Number of Main Cables	2
Diameter of Main Cables	24¼ inches
Number of wires in each cable	12,876
Diameter of each wire	0.196 inches
Total length of cable wire	41,000 miles
Weight of cable, wire and fittings	12,500 tons
Total estimated weight of Superstructure	66,000 tons

The ceremonial groundbreaking for the structure took place on May 7 and 8 at St. Ignace and Mackinaw City, the two terminal communities for the structure. Actual mobilization of equipment began on February 17, 1954. It is stated that the equipment on this job now is greater than that assembled for any other job of a similar nature. It is valued, along with the dock installations, at about $6,000,000. The entire Straits area where the construction of the foundations is underway is tied together by short-wave radio, allowing contractors and engineers immediate communication with all phases of the project.

The 1954 objective was to get a toe-hold in the Straits on the six



Framework construction at St. Ignace for cofferdams 21 and 22. The circular construction is one of the two cofferdams for cable rest pier 21. The three rectangular frameworks are for cofferdam 22.

This is an aerial view of Mackinac Bridge foundation construction. Pier 17 in foreground and causeway at St. Ignace in the upper left corner.

main foundations that will eventually support the center span superstructure. Three of these foundations are of caisson construction and three of cofferdam. The remaining twenty-seven piers will be cofferdam construction.

The anchorage foundations are 135 by 115 feet founded on rock 88 feet below the surface on the south side and 95 feet below the surface on the north side. The cable rest piers, 472 feet from each of the anchorages, are a rectangular caisson on the south side and two circular cofferdams on the north side. The south cable rest pier will be 148 feet in depth to rock. On the north side, the two cofferdams will be founded at 65 feet.

The most challenging of the 1954 construction operations was the sinking of the main tower foundation caissons to depths of 200 feet each. These are open dredge, circular, double-skinned steel shells 116 feet in diameter. The interior circular skin slopes toward the exterior wall forming a cutting edge on the bottom which will penetrate some fifty feet of overburden that will be scooped out of the center with clamshell buckets.

All the concreting on the Mackinac Bridge is being done with the Prepakt-intrusion air method. This involves the strategic placing of grouting pipes in both cofferdams and caissons right down to rock bottom. Alongside the grouting pipes are sounding well pipes, 1-¼ inches in diameter and with a ⅛-inch vertical slit. Aggregates of specific sizes and hardness are dumped into the area to be concreted. When they reach a predetermined height in the caisson or cofferdam, the grout comprised of cement, sand, fly-ash, intrusion air and water to about a pea-soup consistency is pumped through the grouting pipes to the bottom of the aggregate and forced to flow upward, thereby displacing water and filling the voids. This method has a distinct advantage in the Straits area where a continuous concrete pour (tremie) under water would be hazardous because of weather conditions.

Bridge Completion Planned for 1957

Operations will continue until the Straits freezes over which should occur sometime in mid-January or early February. By that time the six main foundations will have been solidly built in place. As soon

as the ice goes out of the Straits next spring, the bridge engineers will move in and start construction of the 552-foot towers on the 200-foot foundations. The substructure builders will continue with the twenty-seven additional marine foundations. Plans for 1956 call for truss spans completed, along with the cable spinning. Current plans set the structure's being opened to traffic by November of 1957. Painting and cable wrapping will be completed the following year.

St. Ignace and Mackinaw City have a combined normal population of less than 5,000. During the summer months vacationists multiply this figure ten times over. Consequently, the contractor's $100,000 weekly payroll provides a tremendous stimulus to the Straits region. This has brought about increased cost of living in the area. Real estate has boomed for more than a year, and prices, by comparison with property not close to the bridge, are very high. It is expected that these conditions will settle back to normal in time, with land values naturally on a higher level than previously. The area is ripe for the development of additional recreation facilities, for timber farming and small manufacturing installations.

According to traffic estimates, 1,900,000 vehicles will cross the Straits in 1958. Most of them will come from more than 200 miles away. Within a 500-mile radius of the bridge some thirty million persons reside. Most of these have never seen, or rarely see, vast bodies of water such as the Great Lakes; nor do they have close access to the winding, fish-filled streams, the rolling hills, and game-filled forests of Northern Michigan.

The average toll per vehicle will be about $3, the same as charged for crossing on the ferries. These revenues will more than meet the $4,242,000 annual interest charge. The remaining revenues will be applied to bond retirement, which should be completed in twenty-five or thirty years, thus providing the people of Michigan and the millions who visit her recreational areas with a magnificent toll-free bridge, at long last connecting Michigan's two peninsulas.

An Approach to O-D Data Analysis

ARTHUR T. ROW

Mr. Row received the degree of Master in City Planning from Harvard in 1948. He was Planning Director for Portland, Maine from 1948 to 1951, and has served as Assistant Director of this study since April 1953.

THE origin-destination study is the means to an end. Yet of the thousands of pages of published material, few are devoted to the end, and practically none to the process of arriving at the end. The purpose here is to submit one approach for proceeding from facts to goal.

Analysis is made up of two components: a framework of logic or sequence of steps; and the methods and techniques used to implement the steps. This paper deals with the former as it has been worked out by the Detroit Metropolitan Area Traffic Study. References to technique have been made only where necessary for clarity.

The philosophy serving as a point of departure for the approach set forth below is that the solution to the traffic problem in an urban area lies in the development of a comprehensive plan or framework of facilities so laid out as to best serve the land use goals of the community.

The arterial system of a metropolitan area is in such sensitive balance that improvements to one segment ultimately affect all other segments, either directly through shifts in traffic loads, or indirectly through influence on the land development pattern. The enormous responsibility of providing for adequate circulation in a large and constantly changing metropolitan area can only be discharged by a total solution.

Admittedly origin-destination data are useful in solving special problems or in testing limited proposals, but the substance of their great potential should not be dissipated in a series of piecemeal applications.

The organization of the Detroit Metropolitan Area Traffic Study reflects an understanding, on the part of the governments underwriting the program, of the need for a comprehensive and coordinated attack. Three points establish this: first, the local bill to match

the federal money is divided equally between the Michigan State Highway Department, the Wayne County Road Commission, and the City of Detroit; second, the Policy Committee,[1] to which the staff is responsible, is composed of the operating heads of the agencies whose responsibility it will be to execute the plans; third, the study is responsible not only for carrying out the survey and analyzing the data, but also for preparing a master road network plan for the area.

With $750,000 available to carry out the operation, with the community pressing for a plan not only because the problem is severe but because a great deal of planning in the City of Detroit has already been done, and because the city is financially prepared to go into construction, the work program has to be a closely reasoned one. Each step must be measured in terms of its potential for contributing directly to the ultimate goal of highway system layout.

Attacking the Problem

The steps in the attack are outlined below. Simple in concept, they obviously include a series of difficult methodological problems. They were arrived at after intensive review of work done with origin-destination data in other cities and after many consultations with planners and engineers with broad experience in this field.

1. Inventory of the travel taking place in the area in 1953.
2. Inventory of the land use and population distribution in the area in 1953.
3. Inventory of the facilities for traffic movement in the area in 1953.
4. From (1) and (3) above, determine the relation between desire for movement and the capacities of facilities to serve the desire in 1953.
5. Determine the relationship between traffic generation and land use.
6. Project the population and land use to 1980.
7. Develop the probable 1980 traffic pattern based on (6), (1) and (3) above.
8. Compare both 1953 and 1980 traffic volumes against existing capacity.
9. Lay out system to meet the needs as derived from (8), with due regard for contracted improvements.
10. Modify both land use forecast and traffic forecasts as necessary because of changes in road network.

[1] Agencies represented are Michigan State Highway Department, U.S. Bureau of Public Roads, Wayne County Road Commission, Huron-Clinton Metropolitan Authority, Detroit Metropolitan Area Regional Planning Commission, Detroit City Plan Commission, Detroit Department of Streets and Traffic, Detroit Department of Street Railways.

11. Assign traffic to the proposed system for adequacy test and design specifications.

12. By comparison of 1953 and 1980 deficiencies (step 8), established a priority list for construction.

13. Test the total system's cost against community's fiscal capacity.

14. Outline a program for continuing review and appraisal of the plan.

I. *The Inventory of Traffic*

This inventory consists of the basic set of origin-destination data. They provide a complete picture of weekday travel at a given point in time within the survey area and between the survey area and the outside world. There are three major groups of information:

a. Travel by residents of the area
b. Travel by trucks and taxis operated within the area
c. Travel into, out of, and through the area by non-residents

The basic unit is the trip and all qualifying data about travel relate to trips. A trip is defined as one-way travel from one place to another which takes a person outside of the block in which the travel started. With the exception of walking trips to work, only trips using some method of vehicular movement were recorded.

Trips made by the interviewed sample of the area residents were defined by time, purpose, mode of travel and place of trip origin and destination.

Trips made by trucks and taxis operated within the area were defined by time, whether loaded or empty, and place of origin and destination.

Trips made in the area by non-residents were defined by time, purpose, vehicle type, and place of origin and destination.

After expansion of the sample, these trips represent a complete inventory of all travel occurring in the study area on an average weekday in the fall of 1953.

II. *Inventory of Land Use and Population*

Travel is made largely by people (although an important segment of the traffic problem lies in the movement of goods). In interpreting the meaning of the travel pattern derived by the travel

inventory above, it is clearly important to know where the population lives, and something about that population. For example, 40 percent of the trips are made by persons going home. Knowing where the population lives, then, explains a good deal about the travel pattern. If one knew how the population were to be distributed ten years from now, one could deduce a large portion of the travel pattern ten years hence.

Further, trip volume per household is directly related to where the household is located. There is a definite correlation between trips per dwelling unit and distance from the city center. This is shown by organization of the survey area into rings in Table I below. Whether or not there is a distinct correlation between travel and such variables as net density, structure type, etc., are questions that are being investigated.

Table I

CHANGES IN TRIP VOLUMES REPORTED BY RESIDENTS WITH DISTANCE FROM THE CITY CENTER OF DETRIOT

(Average weekday, fall of 1953)

Ring	Population	Dwelling Places	Cars Owned	Total Trips Reported	Trips per Capita	Trips per Dwelling Place	Cars per Dwelling Place
1	23,600	16,000	2,050	27,125	1.15	1.70	.13
2	403,225	130,550	75,825	473,550	1.17	3.63	.58
3	790,575	244,200	201,675	1,231,625	1.56	5.04	.83
4	630,660	186,630	200,085	1,298,260	2.06	6.96	1.07
5	631,480	175,370	200,045	1,353,470	2.14	7.72	1.14
6	520,525	142,575	166,055	1,142,315	2.19	8.02	1.16
Total	3,000,065	895,325	845,735	5,526,345	1.84	6.17	.94

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These household data provide a variety of information about the persons making trips and the places in which they live. But while one end of each trip made by persons is most frequently the place of residence, the other end is usually associated with a non-residential land use.

Non-residential land uses, then, play a major role in defining trips. Such things as industries or shopping and business centers concentrate large volumes of day-time population. These non-residential uses also provide a large part of the truck trip termini (goods

movement). These places are known as generators—i.e., they serve to generate trips. Where these are located and the intensity of these kinds of land development, seem to be the principal causative factors in the spatial distribution of traffic.

Knowing the land use distribution, therefore, is critical to any soundly conceived proposal for traffic facility improvement.

In Detroit, the inventory of land use by block was provided by the local planning commissions from records of real property inventories, building permits, Sanborn atlases and aerial photographs. These measures of land usage were used to construct origin-destination zones and are the basis for determining the relationship between land use and traffic generation (step 5) and for estimating future traffic volumes from land use projections (step 7).

III. *Inventory of Facilities*

When the O-D surveyor arrives upon the scene, armed with manuals, schedules and maps, and backed up by calculating machines and drafting tools, he does not find a big blank area waiting to be divided up by expressways. He finds a well-developed street system serving the millions of trips which he identifies. One of the major tasks is to measure the efficiency of that system. In other words, it should be possible to compare the travel-desire volumes and potentials against existing facilities in order to identify problem areas.

Highways and streets are channels of flow in which vehicles move and, like other channels, streets have measurable capacities.

The City of Detroit, the Michigan State Highway Department, and the three County Road Commissions, all or part of whose road system lies within the study area, have jointly agreed on the capacity of their arterial systems. Capacity, of course, depends upon a host of variables: whether parking is allowed or not, whether left turns are allowed, whether the street is in the city or in the country, whether the street has a median strip or not, etc. Some of these are built in, like medians, others are subject to change, like parking restrictions.

If problems are to be defined in an area of 700 square miles, then they must be measured in the same units. Work is presently being done to assure agreement between the operating agencies on the basic measures of capacity so that the problems of deficiency will be

dealt with in terms of a common denominator throughout the area. The capacity measures being constructed aim at a standard of satisfactory service for any through-street in the area after all agreed-upon traffic engineering improvements short of construction have been made.

IV. *Determine Relation Between Desire for Movement and Capacity to Serve the Desire*

The inventory of existing facilities becomes meaningful only in terms of the ability or lack of ability of facilities to serve the travel needs of the area as determined from the traffic inventory. The measure of ability (or lack of it) to serve need is applicable to system planning and to priority allocation only when the test results can be defined by location. In this sense, the planner is primarily concerned with those places where existing facilities fall short of apparent need, that is, are deficient.

Measuring deficiency is more easily said than done. One way to measure deficiency is to determine desirable capacities (Step 3) of major streets, and to count the traffic on those streets; where the latter exceeds the former, there is a deficiency. But if it is reasoned that traffic seeks a level in a system (based upon a common desire to minimize time, for example), then the volume on any given street is partially determined by capacities, pavement conditions, etc., of alternative streets for each of the several movements which have come together on the given street. Excess of volume over capacity on any given street may represent a compromise on the part of the motorists to accept the congestion on that street as the lesser of two evils. The resulting deficiency measure, then, is a symptom of ill, but it does necessarily locate the real place of sickness, just as a skin tumor may not locate the major cancer.

If a measure of deficiency is considered inadequate because it locates the outward symptom but not the real point of the trouble, then the other extreme is to disregard present flow entirely and to relate straight desire-line movement to capacity. The obvious difficulty with this approach is that the street system does not coincide in alignment with desire lines. If desire lines are to be related to

street capacities, some deviation from the straight desire line is necessary. But how much? And in what way are desire lines to be allocated to given street units?

The Detroit study staff is presently experimenting with a method of determining capacity of the primary system throughout the area by major direction (4) in one-mile squares. Knowing the desire volume in each of these squares by major direction, the major directional capacity can be compared with the major directional desire volume.

The technical problems involved in comparing desire with capacity are difficult. The method being investigated may not provide the kind of comparison that is desired. But some comparison of desire against primary street capacity is considered necessary in order to measure the adequacy of the present street system to meet the needs of the area for traffic movement.

At this point in the analysis, the traffic problem of 1953 has been reduced to measurable terms and the analyst knows a great deal about the locations and magnitude of traffic movements. While a construction and improvement program could be worked out from these data, the solution would be an answer to the 1953 problem and it would be well beyond 1953 when the program was transformed from paper to concrete. And if the planner knows anything for certain, it is that the area is going to change.

Further, the area will not change equally in all of its parts; hence, change will produce redistribution of traffic volumes. Since this is nearly certain, it is difficult to justify a program based on an O-D survey taken some years before any improvement is used by drivers. The risk that new facilities may be obsolete before their useful life expires or before the bonds issued to build them are paid off is a risk that must be hedged against as completely as possible.

Therefore, the program must develop a method of designing a highway network that will be valid for the future.

In Detroit two major inventories have been taken of situations that are constantly undergoing change: the traffic, (Step 1) and the population and land use (Step 2). If one of these could be predicted for a future point in time, it should be possible to predict the other for the same point in the future. Within tolerable limits, it should be

possible to predict population and land use for a point in the future. The immediate problem, then, is to derive measurable relationships between land use and traffic from the 1953 data.

V. *Relation of Traffic to Land Use*

It has already been stated that every block in the area was coded to its primary land use. On the basis of these data, the study area was organized into 519 subzones of common land use types.

The following table provides some clear evidence that land use is selective in terms of the reasons why trips are destined to these places. It is clear that each subzone has actual mixtures of land use. Witness the fact that Table II shows some trips to home in all subzones. Nevertheless, it suggests that land use control produces measurable differences in the trip volumes for different purposes.

Additional work is being done by the Detroit staff in two directions. One attack consists of isolating relatively pure land uses and computing the trip volumes to these units of land. These units are being measured in terms of trip per unit of employment and per net acre and per 1,000 square feet of floor area for industrial land.

Net acreage and square feet of floor area are used for commercial and business uses. And net acres and dwelling units are being used for residential land. It is hoped that by control for certain variables such as distance from city center, regression equations can be developed to relate trips to some of the above measures.

Since land usage seldom occurs in large areas in pure form, however, additional exploration is being made to try to relate "normal land use mixes" to traffic volumes generated per net acre. Work done to date suggests that reasonable estimates are possible for zones if the total volume of land in use is known.

VI. *Projection of Population and Land Use to 1980*

The usefulness of formulas to predict trips from land use is, of course, predicated upon the assumption that a population and land use forecast will be available. The Detroit City Plan Commission and the Detroit Metropolitan Area Regional Planning Commission are providing population estimates and land use projections for the

Table II

Percent Distribution of all Internal Trips According to Trip Purpose and land Use of Subzone of Trip Destination—Detroit Area

	Land Use Type	Home	Work	Personal Business	Social Recreation	Change Mode	Eat Meal	Serve Pass.	Shop Dept. Store	Shop Grocery, Drugs	Shop Other	School	Total
Unclassified	0	21.4	36.1	3.5	23.1	1.3	3.5	5.6	.4	1.8	.9	2.3	.6
Single Family	1	51.1	12.0	4.5	13.4	.7	1.9	6.5	.4	4.9	1.9	2.9	63.3
Two Family	2	51.3	16.3	5.4	10.9	.5	1.9	5.4	1.0	3.6	2.2	1.4	5.5
Multiple Residence	3	49.0	22.1	5.1	9.8	.6	1.6	5.0	.2	2.2	.9	3.4	6.0
Retail	4	4.6	33.5	11.0	13.1	1.7	2.1	6.7	13.0	6.8	6.3	1.2	9.1
Other Business	5	5.8	66.2	6.2	7.8	1.4	1.2	5.1	1.0	.4	1.6	3.2	.8
Light Industry	6	13.9	64.3	3.9	7.3	1.1	.8	4.8	.2	1.8	1.2	.8	5.3
Heavy Industry	7	6.9	81.6	2.2	3.0	.3	.4	4.0	.1	.8	.3	.4	7.3
Park and Open Space	8	13.9	15.9	1.7	51.3	3.7	3.2	6.1	—	1.6	.2	2.3	.5
Institution	9	6.0	33.1	12.6	16.2	1.6	.4	7.8	.4	.8	.5	20.6	1.5
Total		40.1	23.6	5.1	12.1	.8	1.7	6.1	1.5	4.2	2.1	2.7	100.0

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year 1980 (approximates). In cooperation with the study staff, these projections are being translated to figures for the zones into which the area has been subdivided for traffic analysis.

Although land use analysis was made on the basis of 519 land use subzones, projections are being allocated to the larger units of land, the 256 zones. Obviously, the larger the land area, the better the chances for accuracy in projections; on the other hand, the areas must be small enough so that they have meaning in terms of traffic projections and traffic interchanges. The 256 zones represent a best compromise between these two divergent criteria.

Application of the formulas to land use and population figures for each zone for 1980 will provide an estimate of the number of trips that would have at least one terminus in each zone in 1980 if the land use develops as projected (or at whatever point in time the land use did so develop). By dividing the 1953 trip termini in a particular zone into the predicted 1980 trip termini in that zone, a factor would be derived which would represent the change in trip volumes between 1953 and 1980. Single, or groups of, external stations would be treated as zones for this expansion.

If all the trip termini in each zone were added together, the sum would be the total trip termini in the area in 1980 and one-half the sum would be the number of total trips. This total should be checked by the total arrived at by at least one other method of projection. One way of doing this is to project the total trips made by households, regardless of where they are made, from the total estimated households; to project a total number of truck and taxi trips from an estimate of truck and taxi vehicles; to project a total number of external trips (i.e., trips made into the area by non-residents); to add the three together and check against the total obtained by the zonal expansion method. Any differences would then have to be reconciled.

VII. *Develop the 1980 Probable Traffic Pattern*

The picture produced by the prediction of trip termini by zone from the preceding section is a static picture. Each zone has a given number of trip ends. But a traffic pattern depicts movement. The

critical question is, "What will the future zonal interchange volumes be?"

The trip termini in each zone are known for 1953, and the zonal interchanges are known for 1953. The trip termini for 1980 have been estimated. From these "givens," the problem is to determine the zonal interchange for 1980. Faced with this problem in Cleveland, Fratar[9] reasoned, "It is clear that for each (interzonal) movement, the volume of traffic will reflect the relative attractiveness of that movement in competition with other possible movements. The relative attractiveness of any interzonal movement will result from changes in traffic generated by the two zones involved relative to changes in the traffic generation of other zones." In other words, the zonal interchanges will redistribute themselves from the 1953 pattern in accordance with the changes in the relative generating power of the several zones in 1980, generating power defined in terms of forecast trip termini in each of the several zones.

The problem, then, is to redistribute the 1953 traffic pattern in a way that reflects both the 1980 volume and the changes in the pattern that will result from the changes in generating power of the several zones. Visualize a situation in which traffic will gradually readjust itself into a "final" pattern that reflects the 1980 trip attractiveness of each interzonal movement in relation to all other zonal movements based upon changes in the generating power of each of the several zones between 1953 and 1980. To achieve this, Fratar suggested a method of successive approximations. Basic to the method are the ideas that: (a) the system is a closed one; (b) the entire system of movement must be treated as a whole, that is, a change in any component affects all other components.

The method is one that repeats a process, each repetition bringing one closer to the "correct" answer. The correct answer is a distribution of interchange volumes in such a way that the trip termini in each zone equals the number of termini forecast for that zone. With certain modifications, the Fratar system is being used as a model for forecasting future zonal interchanges.

[9] Fratar, Thomas J., "Forecasting the Distribution of Interzonal Vehicular Trips by Successive Approximations," paper presented at the Annual Meeting of the Highway Research Board, January 12–15, 1954. This idea derives from Hardy-Cross, University of Illinois Research Sta., Bulletin 256, 1956.

Three components operate in a system of zonal interchanges: (a) The trip-generating or -attracting potential of any zone. (This may be expressed in residential population, number of employees, acres of shopping area or some other unit that represents not only a unit of travel generation but equally a unit of travel attraction). Actually, the best measure is total trip termini. (b) Distance between zones (short distances are more attractive than long ones for interchanges in which the components in (a) would be the same); (c) friction acting in the interchange between zones (where (a) and (b) are the same between alternative interchanges, other elements may make interchange more difficult between zone A and zone B, for example, than between zone A and zone C; this is probably expressed in terms of time). Since (b) and (c) operate in a similar manner, i.e., both operate to modify an interchange system based on (a), and because it is difficult to separate the weight of one component from the other, they may be combined to represent a friction factor.

The trip-generating or -attracting potential is already known for each zone, but the friction factor is not. It appears that if the friction factor can be determined, the interchanges can be solved using some method of successive averaging. The first assumption made is that the 1980 interchange pattern will be a variation from the 1953 pattern modified by changes in land use (i.e., zonal termini). Friction factors are already operating in the 1953 situation. Hence these factors which have produced the 1953 pattern are retained in the first forecast of traffic.

While all of the theory for these projections has not yet been completely tested, it seems clear that it is feasible to make a redistribution of trips which will be consistent with the change in zonal trip potentials and will produce interchanges in which the same friction constants approximately obtain for each zonal movement. This does not mean that the street and transit systems are the same in 1980 as in 1953, but rather that improvements of sufficient magnitude are made to keep each movement with new volumes of traffic about as well served in 1980 as it was in 1953.

Thus the zonal interchange pattern for 1980 would be developed. Yet, because of the assumptions that have gone into this system, a new program of major highway improvements will modify the friction factors and also the land development pattern. A system for solving these friction factors is being worked on so that it is hoped

that the insertion of new friction factors and new zonal volumes will make it possible to reallocate zonal interchanges to estimate the full effect of new facilities before traffic assignment is made.

One further step is necessary before an acceptable 1980 traffic pattern has been produced. The trips must be distributed between alternate means of transport. The trips with which the highway planner must deal are those made by auto and truck drivers plus those by transit vehicles operating on the street. The problem of distribution among alternate means is still under study. Present reasoning assumes that for any given interchange in 1980, transit service will be relatively as good in 1980 as it is today, and that modal distributions (auto, passenger, truck passenger, transit passenger) will be in the same relationship in 1980 as today. That is, the first traffic estimate will distribute any zonal interchange in the same proportion at time two (1980) as was the case at time one (1953).

VIII. *Test the 1980 Desire Against Capacity*

This step should be done in the same manner as the test for 1953 except that the capacity measures would be revised where necessary to reflect the shift in certain of the outer areas from rural to urban characteristics.

The result should be a general definition of the areas of deficiency in 1980 and a measure of their relative degrees of severity. This step provides a picture of existing and of expected future deficiencies and furnishes the point of departure for the next step.

IX. *Lay Out Improved Arterial System for 1980*

This is the critical step in the process. Up to this point, objectivity has been the keynote; judgment has necessarily entered at such points as determination of zone sizes and boundaries, but the emphasis has been upon objective and scientific tests and measurements to assure as accurate a definition of the problem as possible.

Two possible situations can develop. The first is that the display of probable traffic pattern and of areas of deficiency will be so clean cut that the solution is obvious (in concept at any rate). The other is that the deficiencies will not fall into a pattern, that the projected traffic movements will not arrange themselves into neat designs and

that an extremely imaginative approach requiring the creation of several alternate designs for test will be required. The actual situation will probably be somewhere between the two and probably nearer the first than the second.

It should be remembered that the master plan is a system layout without route locations designated in general terms. Land cost, soil conditions and similar factors affecting final location must be determined by the design engineer. Nevertheless, the plan must provide substantial detail. It must reflect factors which restrict the task of the right-of-way selector to narrow limits, else much of the work to this point has been wasted.

At this point the land use element enters the situation in a different way from heretofore. Land use has been considered in terms of its contribution to the traffic pattern, not in terms of a component of the urban structure which has real interests of its own. Clearly, there will be conflicts between the optimum location of a given expressway to serve a measurable need for movement and the interests of the community to preserve particular land use nuclei from encroachment or destruction by that expressway. While many smaller problems can be solved when detailed construction drawings are made, the major ones must be solved as general routes are described. This is particularly true of urban expressways. These are 330 feet wide and produce major barriers to cross-movements. They should serve to bound rather than split those urban areas which the community plan envisions as places containing major pedestrian and local movements.

The proper approach appears to be for the highway planner to lay out an optimum system from a highway point of view. Then he must subject his plan to review by the agencies responsible for planning other phases of the metropolis's development, and together a system must be worked out which provides as good a highway solution as possible consistent with the valid requirements of the community to maintain and develop a desirable land use pattern. The highway system is the circulation system; it *serves* the community and its needs for movement; it does not dominate it.

Thus, it is axiomatic that proposals made must be reviewed and any final plan accepted by the traffic and planning agencies of the units responsible for translating the plan to reality.

X. *Modify Original 1980 Forecast by Virtue of the Proposed New and Improved Facilities*

As indicated in the discussion of Step 7, it is believed possible to measure the postulated friction factors of zonal interchange. New facilities will of course make certain zone-to-zone movements easier in relation to alternate movements; that is, the construction of an expressway will lubricate certain movements by improving channels of flow selectively. This should naturally re-direct more trips between the affected pairs of zones. Hence, calculation of the revised friction factors suggests that new values can be inserted in the forecasting formulas and travel redistributed so as to take full account of the improvement to the system.

At the same time, it is clear that construction of new expressways will, by making certain lands more accessible to other parts of the urban area, induce land development along the route at a more rapid rate. While there is no existing rule to follow, it is anticipated that once routes have been selected, the spatial distribution of new growth must be reviewed and relocated to take this new influent into account. This relocation of growth will tend to raise trip potentials at zones served by the new facilities and will further increase accordingly traffic volumes between pairs of zones served by the new facilities. It is the staff's opinion that these adjustments must be made prior to assignment of future traffic volumes.

XI. *Test Proposals by Traffic Assignment*

By the time a complete tentative system has been developed, reflecting compromises from the ideal to conform with the community's land use goals, the result will have departed to some degree from the first optimum (diagrammatic) layout. The system now should be put to the test of its potential service.

The test is the assignment of vehicles (trips) to actual sections of the proposed system. Assignment requires some rational method which will reflect as accurately as possible the probable use of the facility. Considerable time has been devoted to measuring usage of facilities today in terms that can be applied for predictive purposes. For the most part, these investigations have revolved around time

and distance measures, although other variables have been tested. A major task is to develop a method that will produce a high degree of accuracy yet can be applied by calculating machine methods, since assignment by other than calculating machine methods would be extremely time-consuming.

Assignment of traffic provides the basis for actually determining the efficiency of new facilities. From assignments, costs can be related to benefits. Only by assignment of traffic can interchange locations, ramp sizes, number of lands and other design requirements be provided. And finally, only by assignment of trips can the system be tested in terms of its service to the future traffic demand.

XII. *Establish Priorities*

All new construction required to meet the future traffic demand and to correct for existing deficiencies is not of equal urgency. Hence, to follow the precept of first things first, a system of priorities should be established. Those items required to improve existing deficiencies as determined in Step 4 would probably rate high priority. This would be especially so if the future forecast suggested a steadily increasing service deficiency. Other units of the plan may be required to meet future demand. Thus, rights-of-way might be reserved by subdivision control, official map procedure, or purchase in sparsely developed areas. With an anticipated increase of some 45 percent in population and 55–60 percent in vehicle ownership in the next twenty-five years, a program of substantial size is expected. As shown below, the low priority items may well have been subjected to careful review by the time the community is prepared to let construction contracts.

Priorities are thus a critical element to any program and it should be the responsibility of the traffic planner to suggest the proper priority of new work.

XIII. *Test Cost Against Community's Fiscal Capacity*

No long term plan is sound unless it is within the means of the community. Of course, construction of a highway system in accordance with a long range plan will take place over many years and the community's financial capabilities will change. Nevertheless, the

initial plan must be in reasonable balance with the community's ability to pay for it insofar as that ability to pay can be foreseen. Three factors come into play in the measure of financial feasibility:

a) The total tax base of the community, including its proportionate share of state and federal money and including motor vehicle use tax returns.

b) The competition of needs for other public works.

c) The value, in dollars and cents, to the community of the proposed improved highway network.

The traffic study will not measure factors (a) and (b). Since they involve policies and problems beyond the highway program itself, data should be provided by other agencies as *givens* just as the future land use pattern is a *given.*

The traffic study can be expected to make gross estimates of the proposed system's total cost and gross estimates of the dollar benefit to the community of the proposed system.

In effect, the task of the traffic study in this phase of planning is seen as providing its best estimates of the factors to be considered ultimately, to executive and legislative bodies responsible for management of the community's purse. This best estimate must include not only costs but estimated returns in dollar value, and timing or rate of construction alternatives.

XIV. *Establish Program of Continuing Review and Test*

The study staff believes the sequence of steps outlined above is a logical method of attacking the job. But to believe that the future will develop exactly as predicted would be fatuous to say the least. Factors that cannot be foreseen in 1953 will certainly come into play before 1980. But the introduction of new factors, or unforeseen shifts in population distribution or in land development need not invalidate the program. It would be unfortunate if the $750,000 planning program were out of date in 1960; yet it would be out of date unless some method were developed for keeping it current.

It is axiomatic to planners that planning is a continual process, not a "one shot" job. Therefore, some continuing agency or agencies should be responsible for making periodic reviews of the situation and revising the program as necessary.

At this time, three lines of stock-taking of traffic appear feasible.

Certainly an agency charged with the continuing responsibility would develop more. The three are:

a) a continuing revision of the land use data to keep them current, hence a continuing revision of the projection factors of traffic and the resultant trip distribution.

b) a program of traffic-counting to measure shifts in traffic load and analyses of these to determine the reasons therefor.

c) a program of small scale but repetitive home interviewing to determine change in travel habits that can be applied to a correction of original large scale data.

The development of an outline program of work for such a continuing review is considered one of the responsibilities of the present study staff.

Summary

The outline presented has been revised frequently as the study has progressed. The program of analysis is currently in the midst of steps 3, 4, 5 and 6. Many difficult methodological problems remain to be solved and experience to date has shown that solutions to these problems and findings in the course of the program may alter the program itself.

The outline is presented, however, for the two following reasons: First, because of the variety of possible approaches to the problem of metropolitan traffic analysis and road network planning; second, because no complete system of analysis has been published, proceeding from a compilation of origin-destination data, through the several phases of their analysis, to their being used to help create a metropolitan highway plan that provides for the use of these objective data in limiting the areas of intuitive judgment.

The Detroit study is a long way from that never-never land where O-D data can be fed into one end of an electronic calculator and a master highway plan issued from the other. But the Detroit study staff is convinced that objective use of the factual information obtained from an O-D survey can provide limits within which choices can be made and also provide a measure of the effects of alternate choices.

Statistics on Truck Ownership and the Use Obtained by Sampling

DONALD E. CHURCH

For the last three years Mr. Church has been Chief of the Transportation Division, Bureau of the Census. He has concentrated on developing efficient methods for collecting statistics in the general field of transportation. During the previous ten years he was engaged principally in transportation research for the Department of Agriculture, Transportation Corps (Army), War Production Board, and other federal agencies. In addition, he taught economics and statistics, served as a consultant on market potentials, and as a general business analyst for private firms.

THE Bureau of the Census is engaged in small-scale experimental and exploratory work to develop efficient techniques for collecting and presenting comprehensive statistics in the field of transportation.[1] Since a considerable body of information is issued by government and private organizations, the basic aim of the bureau's program is to develop methods to collect and tabulate data needed to fill important gaps to serve the needs of carriers, shippers, suppliers, government agencies, other organizations, and individual investigators.

Since one of the most widely recognized gaps in transportation statistics is the general lack of comprehensive data on truck transportation—especially on the inventory, ownership and use of private

[1] More specifically, Title 13, U. S. Code, Chapter 5, Sub-chapter 1, paragraph 131, directs the Bureau to take a census of " . . . transportation (exclusive of means of transportation for which statistics are required by law to be filed with, and are compiled and published by, a designated regulatory body), in the year 1954 and every fifth year thereafter" (for data concerning the preceding year) and authorizes " . . . such surveys as are deemed necessary to furnish annual or other interim current data . . ." The 1954 Census was indefinitely postponed because Congress did not appropriate funds for this or any of the other economic censuses. Statutory authority and funds subsequently were passed by Congress for the Censuses of Manufactures, Mineral Industries, and Business in 1955. Corresponding action was not proposed for transportation, principally because the Intensive Review Committee (established by the Secretary of Commerce in 1953 to appraise the major Census programs) recommended that activity in transportation be limited to experimental and exploratory studies pending a further review of the need for and feasibility of taking a census of transportation. The Committee "found broad interest in more and better data on transportation, but considerable difference of opinion on specific needs and serious doubts as to the feasibility of parts of the proposed program." The Secretary of Commerce has instituted a further review and the Bureau is continuing small-scale exploratory and experimental work.

and exempt for-hire trucks and combinations—an experimental project was undertaken to develop and test specific methods for collecting essential information in this field.

Test Survey on Truck Inventory and Ownership

A small-scale survey was conducted in five states in 1952 to test the effectiveness of a proposed sampling method and to obtain experience needed to improve the report form and procedures.[1] Information was tabulated for approximately 2,000 in-scope cases, distributed about equally among the states of Maine, Michigan, Missouri, Pennsylvania, and Washington. The method used consisted of four basic steps:

1. Detailed information on the license numbering system used in each state was obtained from motor vehicle registration officials.

2. A sample of license numbers was drawn in such a manner that each license plate issued to trucks and truck-tractors in the state had a known (i.e., mathematically determinable) chance of being drawn in the sample.

3. Those license numbers were matched with state records to identify the vehicle and the owner to whom the license was issued.

4. Reports were obtained, primarily by mail, from the registered owners concerning the vehicles that carried the specified license numbers on the survey date (June 30, 1952).

Information from truck owners was obtained by a mail questionnaire (Form TPN-1) concerned with facts that the general cross-section of truckers were believed to be able to answer readily. However, the same basic sampling technique can be used to obtain many other types of information, provided the collection procedures include a step by which satisfactory arrangements are made in advance with the owner for keeping suitable records or "logs."

Illustrative Statistics Obtained in Test Survey

The general range of statistics that may be developed by a mail questionnaire in connection with the basic method outlined above

[1] For a more complete description of methods and results, see "Report of Test Survey of Truck Inventory and Use," prepared by the Transportation Division, Bureau of the Census, Department of Commerce, Washington 25, D. C. Price 50 cents.

is illustrated by Tables 1–6. These tables[8] are based on test survey returns for private, exempt for-hire and leased trucks and combinations registered as of June 30, 1952; and represent, essentially, total property-carrying vehicles in the five selected states, except for the following types:

1. Vehicles owned by federal, state, and local government agencies.
2. Vehicles owned by or leased to interstate for-hire motor carriers subject to rate and other economic controls by the Interstate Commerce Commission.
3. Vehicles not registered anywhere—primarily heavy vehicles for off-the-highway use, and yard birds that remain on private property at all times.

Most of the figures are quoted in terms of percentage distributions because the major contribution of a survey on this scale is the relative distribution of vehicles or vehicle miles by such characteristics as occupational use, vehicle size, body type, etc.

Table 1 is of interest principally as an indicator of the market for trucks and combinations, by body type. Three body-type classes (pick-up or express, panel or sedan delivery, and platform or stake bodies) account for about three-fourths of the vehicles. Wide differences exist among the major occupational classes. Dump trucks amounted to only 8 percent of the total, but were the largest class of the vehicles (35 percent) used for exempt for-hire and lease service. A large part of those dump trucks probably are owner-operated vehicles working under lease or other arrangement for construction firms or distributors of sand, gravel, and crushed stone. Van type trucks present another striking illustration. Refrigerated and nonrefrigerated vans combined represented only about 5.4 percent of the total trucks in the survey, but were 25.9 percent of the total used in wholesale trade.

The "occupational use" groups correspond, as nearly as possible, to the major divisions or classes of economic activity as defined in the

[8] Since the estimates presented in Tables 1–6 are based on samples, they will, in general, differ somewhat from the figures that would have been obtained if a complete enumeration had been made using the same procedures. As in any survey, especially when undertaken in a new field, the results are also subject to errors of response and reporting. The approximate sampling errors are presented in Table 7. Response errors and other limitations are discussed in other parts of this article.

Table 1

FIVE STATE SUMMARY:

Percentage Distribution of Private and "Exempt" For-Hire Trucks and Combinations, by Body Type and Occupational Use, June 30, 1952

Occupational use	Number of cases in sample	Percentage distribution by body type									
		Total	Pickup or express	Panel or sedan delivery	Multi-stop	Platform or stake	Van		Dump	Tank	All other[1]
							Non-refrig.	Refrig.			
For-hire and lease	198	100.0	5.2	7.8	1.0	25.1	10.4	1.6	35.0	6.9	7.0
Private business:											
Farming	471	100.0	56.3	3.4	...	35.7	0.5	...	2.8	...	0.8
Construction	241	100.0	49.4	19.7	...	17.6	0.7	...	9.3	...	3.3
Manufacturing	219	100.0	17.4	12.5	7.4	25.5	11.5	2.7	9.0	1.9	12.1
Wholesale trade	183	100.0	16.2	10.8	3.9	20.9	21.5	4.4	2.9	15.6	3.8
Retail trade	268	100.0	28.1	26.0	11.0	16.6	5.5	0.7	6.3	5.5	0.3
All other private	200	100.0	31.0	28.4	5.8	5.6	1.8	...	11.5	0.5	15.4
Total	1,582	100.0	39.6	14.4	3.8	23.5	4.7	0.8	6.0	2.7	4.5
Incidental use	238	100.0	74.0	13.1	...	10.4	...	...	2.5	...	...
Total	2,018	100.0	40.7	13.8	3.2	22.1	4.6	0.8	8.0	2.7	4.1

[1] Includes those not reporting on body type.

Note: See Table 7 for approximate sampling errors.

"Standard Industrial Classification,"[4] and used in most census tabulations. Incidental use is an extra class to represent vehicles that are not in any occupational class, such as trucks used predominantly for personal transportation from home-to-work, fishing trips, and other activities that are not directly related to property hauling for hire or for some business activity.

Table 2 shows the distribution of private and exempt for-hire and leased vehicles, by weight group by state. On the basis of the three broad weight classes, the relative importance of each group is basically alike in four of the five states. However, there is a significantly different distribution in Maine.

Each vehicle was assigned to a weight class on the basis of the carrying capacity of the tires on the vehicle. Tire capacity was used because uniform information was not obtainable from state records; and many owners are unable to give reliable answers concerning the gross vehicle weight rating for their trucks or combinations, especially for the older models.

Table 2

PERCENTAGE DISTRIBUTION OF PRIVATE AND "EXEMPT" FOR-HIRE TRUCKS AND COMBINATIONS, BY STATE AND WEIGHT CLASS: JUNE 30, 1952

Weight class	5 State total	State				
		Maine	Michigan	Missouri	Pennsylvania	Washington
Light:						
5,000 lbs. and under . .	39.7	29.9	35.9	42.0	42.5	39.3
5,001–10,000 lbs. . . .	19.9	18.3	23.6	19.3	18.0	19.6
Total	59.6	48.2	59.5	61.3	60.5	58.9
Medium:						
10,001–16,000 lbs. . . .	20.0	25.7	20.6	21.1	18.5	19.2
Heavy:						
16,001–26,000 lbs. . . .	16.0	22.4	14.7	13.9	16.9	16.6
26,001 and over	4.4	3.7	5.2	3.7	4.1	5.3
Total	20.4	26.1	19.9	17.6	21.0	21.9
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of cases in sample	2,024	387	416	425	369	427

NOTE: See Table 7 for approximate sampling errors.

[4] The Standard Industrial Classification Manual was prepared by the Bureau of the Budget, and is used generally by federal agencies in reporting data for classes of industry and business.

Table 3 presents a comparison of the distribution of vehicles by occupational use in each of the five states. As would be expected, the distributions differ significantly from state to state, reflecting in large part differences in economic activity.

Table 3

PERCENTAGE DISTRIBUTION OF PRIVATE AND "EXEMPT" FOR-HIRE TRUCKS AND COMBINATIONS, BY STATE AND OCCUPATIONAL USE: JUNE 30, 1952

Occupational use	5 State total	State				
		Maine	Michigan	Missouri	Pennsylvania	Washington
Commercial:						
For-hire	6.9	7.5	7.3	9.6	6.7	2.7
Lease	1.1	0.4	0.8	0.7	2.1	...
Total commercial	8.0	7.9	8.1	10.3	8.8	2.7
Private:						
Farming	29.3	30.7	24.8	41.2	21.7	36.7
Mining	1.0	0.2	0.8	0.3	1.8	0.7
Construction:						
General	2.6	3.1	1.7	3.3	2.6	2.9
Special trades	8.5	3.9	10.8	5.2	9.5	9.4
Manufacturing	8.6	11.2	9.8	5.5	8.9	9.5
Public utilities and transportation, except for-hire	3.3	2.4	3.9	2.4	4.2	1.6
Wholesale trade	7.8	5.1	9.9	4.5	8.7	8.0
Retail trade	13.7	15.6	14.5	10.3	17.3	8.0
Services, except truck rental	6.4	2.8	6.6	5.5	7.7	5.5
Total private	81.2	75.0	82.6	78.2	82.4	82.3
Incidental use	10.8	17.1	9.3	11.5	8.8	15.0
Total reporting	100.0	100.0	100.0	100.0	100.0	100.0
Number of cases in sample	2,018	386	413	423	369	427

NOTE: See Table 7 for approximate sampling errors.

Annual vehicle mileage is one of the most useful general measures of the intensity of vehicle use. Table 4 shows the average annual vehicle mileage for the twelve months ended June 30, 1952, by major occupational use. In general, the lowest average annual vehicle miles were reported by trucks that were used for "incidental" purposes and on farms, and the highest averages were reported by the "exempt" for-hire and lease vehicles. However, the average annual

mileages for all classes shown on the table are low as compared with the average for power units of major carriers in intercity service.

For example, farm trucks in the five states average about 6,000 miles per year, manufacturers' trucks about 15,000 and the exempt for-hire and leased trucks nearly 20,000 miles per year. Those figures compare with more than 50,000 miles per year for power units in intercity service operated by Class I Motor Carriers of Property. The low averages for the vehicles in this survey are doubtless influenced by two factors. One is that many firms and persons own trucks as a matter of convenience and do not expect to operate them more than a relatively small part of the time. The other is the predominantly local and short haul character of the operation of these vehicles, in which a large part of the day, even when in use, is spent standing rather than moving.

Table 4

AVERAGE ANNUAL MILEAGE FOR PRIVATE AND "EXEMPT" FOR-HIRE TRUCKS AND COMBINATIONS, BY STATE AND OCCUPATIONAL USE: YEAR ENDING JUNE 30, 1952

Occupational use	5 State total	State				
		Maine	Michigan	Missouri	Pennsylvania	Washington
For-hire and lease	19,600	16,700	22,100	19,000	19,000	18,900
Private business:						
Farming	6,200	6,200	5,500	6,800	6,400	6,000
Construction	9,200	12,700	8,400	9,900	9,700	7,800
Manufacturing	14,800	16,200	17,300	15,400	13,600	12,500
Wholesale trade	18,100	18,500	19,600	27,200	14,800	16,500
Retail trade	9,900	11,500	10,900	9,800	9,200	8,900
All other private	11,100	12,900	12,500	6,800	11,900	9,700
Total private	10,000	10,800	10,800	9,400	10,100	8,600
Incidental use	6,100	6,300	6,900	6,900	5,000	6,400
All classes combined[1]	10,400	10,500	11,400	10,200	10,400	8,600

[1] Includes those not reporting on occupational use.

Table 5 presents aggregate miles for each type of vehicle, and is a better measure of street and highway use than the number of vehicles or average miles per vehicle. Pickup or express and platform or stake trucks lead all other types in terms of aggregate vehicle miles, but not by as much as they do in terms of the relative numbers of vehicles.

For some purposes, a tabulation of aggregate vehicle miles by gross vehicle weight would be more useful than one by body type or occupational use. That, as well as many other tables, could be prepared from the information collected on the report form.

Table 5

PERCENTAGE DISTRIBUTION OF TOTAL MILEAGE FOR PRIVATE AND "EXEMPT" FOR-HIRE TRUCKS AND COMBINATIONS, BY STATE AND BODY TYPE: YEAR ENDING JUNE 30, 1952

Body type	5 State total	State				
		Maine	Michigan	Missouri	Pennsylvania	Washington
Pickup or express	32.4	33.4	33.0	37.4	28.2	36.3
Panel or sedan delivery	12.7	5.6	11.6	7.2	18.2	10.1
Multistop	3.7	4.0	5.4	3.0	2.8	4.0
Platform or stake	19.6	30.3	19.5	20.9	17.0	20.4
Van:						
Nonrefrigerated	8.7	3.7	11.6	8.3	7.8	7.4
Refrigerated	1.6	0.5	1.4	2.2	1.9	0.9
Dump	9.8	10.6	7.1	8.9	13.9	3.8
Tank	6.0	7.7	2.9	6.9	6.9	8.1
Other	5.5	4.2	7.5	5.2	3.3	9.0
Total reporting	100.0	100.0	100.0	100.0	100.0	100.0

In view of the widespread interest in comprehensive statistics on vehicle miles per gallon of gasoline, the test survey included a question on this point as an experiment. It was known that most owners would not be able to answer this question on the basis of records, but it was hoped that most of them could estimate miles per gallon for their own vehicles reasonably well. If adequate data cannot be obtained in this manner, different and more expensive survey methods would be needed.

Table 6 presents the averages reported in the test, by vehicle weight and state. Medians were used to avoid undue influence by a few reports of unusually high or low values which were believed to be unrealistic.

The general level and shape of the curve for all vehicles combined in the five-state area appears to be reasonable in comparison with estimates derived from other sources; and the basic stability among the states in each gross vehicle weight class gives considerable strength to the impression that the averages may be fairly good.

However, a systematic test of the quality of the response is needed before a definite conclusion can be reached concerning the reliability of the gasoline consumption data.

Table 6

MEDIAN MILES PER GALLON FOR PRIVATE AND "EXEMPT" FOR-HIRE TRUCKS AND COMBINATIONS, BY STATE AND WEIGHT CLASS

Gross vehicle weight (pounds)	5 State total	State				
		Maine	Michigan	Missouri	Pennsylvania	Washington
5,000 and under	14.2	14.8	14.3	14.8	13.7	14.3
5,001–10,000	12.8	13.2	12.7	13.9	11.7	13.7
10,001–16,000	9.9	11.1	9.9	10.9	9.0	9.8
16,001–26,000	8.4	9.6	8.2	9.5	7.5	8.7
26,001 and over	5.3	6.5	6.1	5.2	4.5	4.9
All classes combined	11.9	11.9	11.8	12.9	11.2	12.3

Sampling Based on License Numbers

The use of registration records as a basis for sampling involves some special problems that are more significant than was realized prior to the test survey. The most important of these is the "transfer problem." This arises from the fact that licenses in some states may be transferred to other persons or vehicles, and consequently the information for a given license number obtained from the registration files may not be correct for the survey date.

Roughly half of the states require the license plate to remain with the vehicle but allow it to be transferred to another owner; most of the other states require the plate to remain with the owner but allow it to be transferred to another vehicle of the same general class. A few states permit both kinds of transfers and some do not permit transfers of any kind.

As mentioned previously, the first step in sampling was to select a sample of *license numbers* from all those known to be currently issued to trucks and truck-tractors. Then the files were examined to obtain information concerning the particular vehicles (make, year model, and size) and the names and addresses of the owners to whom the specified sample license numbers were issued. If there were no transfers of license plates, it would be sufficient in all cases to obtain

reports from these owners for the specified vehicles. Since some transfers inevitably take place before the owners are queried, it is necessary to give an unbiased rule to decide which vehicle, if any, should be reported. If this were not done, some vehicles would have no chance of being included in the sample and others would have more than one chance of inclusion, resulting in potentially serious biases.

A simple rule which solves this problem is to obtain a report in each instance *for the vehicle that carried the specified license number on a specified day*. That specified day is referred to as the survey date.

In this way, it is assured that each vehicle in operation on the survey date has a known probability of being selected; and, conversely, any vehicle not in operation at that time has no chance of falling in the sample. Therefore, unbiased estimates for the population of vehicles at that time can be made.

The possibility of a report being returned for the wrong vehicle is minimized, since only one vehicle can use the license number at a given point in time. In states where the plate remains with the vehicle, it will occasionally be necessary to follow vehicle transfers to get a report from someone other than the original owner. This expense can be minimized by selecting a survey date that is early in the registration year, and by drawing the sample and conducting the survey as soon as possible after the state license files contain all of the registrations through the survey date.

Specific Sampling Instructions

As a rule, heavy trucks are of more interest in proportion to their numbers than are medium and light trucks. For this reason, it is desirable to sample heavy trucks at a higher rate. In the test survey, this was accomplished in one of two ways, depending on the license numbering system used in a state.

In some states, different blocks of license numbers are reserved for vehicles of different weight classes. In such cases, a stratified sampling technique is used, calling for sampling at different rates within different license blocks. A hypothetical set of sampling instructions for a design of this kind might be:

License groups with letter prefixes—	Gross vehicle weight classes	Take all numbers ending in	Sampling rate
CA–CJ	10,000 or less	287 and 787	1 in 500
CK–CS	10,001–16,000	39	1 in 100
CT–CZ	16,001 and over	06 and 56	1 in 50

Other states assign all commercial vehicles, regardless of size, to a single block of license numbers. Normally, however, the information on the registration cards or listings in the files shows some measure of capacity, such as gross vehicle weight, empty weight, or rated capacity. In these states a double sampling scheme can be used. Two samples of license numbers are designated. For one of the samples, the weight entry on each registration is examined and only those exceeding a specified weight are retained in the sample. For the other sample, all registrations are included, regardless of weight. A hypothetical set of instructions for this procedure would read:

1. Take all license numbers ending in 43.
2. Take license numbers ending in 93 whenever gross vehicle weight of registered vehicle exceeds 10,000 pounds.

This would have the effect of sampling light trucks at 1 in 100 and medium and heavy vehicles at 1 in 50.

The methods described could be used to control sampling rates for other characteristics in addition to weight. For example, if greater detail or reliability were needed for recent models than for older vehicles, it would be a simple matter to apply the double sampling technique in order to sample recent year-models at a heavier rate or even to sample only vehicles of given year-models. The basic requirement, in general, is that either the registration form or the license number itself contain sufficient information to classify almost any vehicle with respect to the controlling characteristic.

Size of Sample Needed

The size of the sample needed in any survey depends primarily on the degree of detail and reliability that is required. A key factor for a national survey is the number of geographic areas for which data of a given degree of reliability must be obtained. A much larger sample would be needed to obtain separate statistics for each of the nine

geographic divisions used in census reports than would be needed for national totals with the same degree of detail and reliability.

In general, the size of the sample required for a given degree of detail and *relative* reliability for one area is practically the same as for another. Within broad limits, it makes little difference as to whether the area is large or small, or whether the truck population is in the thousands or hundreds of thousands, or even millions. Stated differently, the number of cases needed in a sample to obtain reliable data for the State of California would be essentially the same as would be required for corresponding data (i.e., same detail and *relative* reliability) for Nevada, or for the Middle Atlantic States as a group, or for a large county or metropolitan area.[8] Consequently, a national survey that would supply statistics for each of the forty-eight states and the District of Columbia would require a sample about five times the size that would be needed to supply comparable data for the nine regions, but only a very small fraction of the one that would be needed to obtain corresponding statistics for each of the more than 3,000 counties in continental United States.

Another major determinant of sample size is the extent of detail and reliability needed within each of the geographic areas for which data are to be shown. In order to simplify the discussion of this phase, reliability (i.e., sampling error) is treated in terms of *relatives* or percent distributions. In general, the reliability of an estimated percentage depends upon both the size of the percentage and the number of sample cases in the total on which it is based, as shown in Table 7. To be more specific, the sampling error for four hundred cases is about 2.5 percentage points on an item that represents half of the total, but smaller on items that represent larger or smaller portions, such as 1.5 points on either a 10 or 90 percent item, or 0.7 points on a 2 or 98 percent element. The corresponding errors (smaller in each case) for percents based on 1,000 cases are 1.6 percentage points for a 50 percent item, 0.9 points for a 10 percent or 90 percent item, and 0.4 points on a 2 or 98 percent element.

[8] Those generalizations apply when the actual number of cases in the sample does not constitute a substantial part of the total population. However, smaller samples should be used for areas (such as small counties) where the sample size required for a very large area would represent a significant proportion of the population of the smaller area. For further technical discussion, see "Sample Survey Methods and Theory," Hanson, Hurwitz and Madow, Vol. I, especially pages 122–129.

Table 7

APPROXIMATE SAMPLING ERRORS FOR PERCENT DISTRIBUTIONS

If the estimated percentage is:	and if the number of sample cases included in the base is: 100	200	400	1,000	2,000	5,000
	then the chances are about 2 out of 3 that the difference due to sampling variability between the estimated percentage and the figure that would have been obtained from a complete count is less than:					
2	1.4	1.0	0.7	0.4	0.3	0.2
5	2.2	1.5	1.1	0.7	0.5	0.3
10	3.9	2.1	1.5	0.9	0.7	0.4
25	4.3	3.1	2.2	1.4	1.0	0.6
50	5.0	3.5	2.5	1.6	1.1	0.7
75	4.3	3.1	2.2	1.4	1.0	0.6
90	3.0	2.1	1.5	0.9	0.7	0.4
95	2.2	1.5	1.1	0.7	0.5	0.3
98	1.4	1.0	0.7	0.4	0.3	0.2

NOTE: The chances are about 19 out of 20 that the differences would not exceed twice the values shown in the table.

How to use the table.—To find the sampling error for a given percent in Tables 1, 2, or 3, first find the number of sample cases included in the base as shown on that table. Use this figure to determine which column of Table 7 to enter. Straight line interpolation between rows and columns will give approximately correct values for percents and bases not shown in the table.

Illustration.—According to Table 1, platform or stake trucks account for 22.1 percent of the total vehicles in the five states combined. The number of cases in the sample for that line is shown to be 2,018. Table 7 shows that the sampling variability for that combination of sample size and percent is about 1.0 percent. Therefore, the chances are about 2 out of 3 that the percentage obtained from a complete count would be between 21.1 and 23.1 percent (i.e., 22.1 plus or minus 1.0).

Difference of two percents.—If it is desired to find the sampling error of the difference between corresponding items in two states, this may be done by taking the square root of the sum of the squares of the values for the two items. In general, the sampling error of a difference depends also on the correlation between the two items, but will not exceed the sum of the values shown in the table for each item.

Type of Questions Asked

Some truck owners keep detailed operating records, but most do not. Consequently, the information sought in the test survey was restricted to facts that a cross-section of truckers could answer or estimate without reference to detailed records. In general, questions were concerned with observable characteristics of the vehicles, general type of use, and some operating facts that most truck owners can

estimate reasonably well. The specific questions and instructions were contained in report Form TPN-1.

Questions concerning tons or ton-miles of service during the past year, average load, percent of vehicle miles loaded, and many other highly significant operating facts were not asked because relatively few truck operators could give reliable estimates. This type of information for trucking in general probably can be obtained if arrangements are made in advance with the sample of truck owners to keep specific records during a short reporting period, but the field operating procedures are different and more expensive.[6]

The wording of some of the questions and the format of the questionnaire caused some difficulty, and should be revised. The occupational questions should be recast to avoid misinterpretation and to obtain more detailed information on this aspect. The question on axle arrangement (item 2 on TPN-1) was overlooked by a considerable proportion of respondents, evidently because it appeared to be a part of item 1. An additional inquiry, with reporting instructions, is needed to deal adequately with the transfer problem described in an earlier section of this article. Some other questions might be added in future surveys, and perhaps some should be dropped. The potential range of facts that can be obtained appears to be rather wide, so long as the questions do not become unreasonably numerous or difficult to interpret and answer.

Rate of Response

The rate of response was high, particularly in view of advance predictions from some sources that truck owners as a group would not be inclined to answer mail inquiries. Only 2.7 percent of the total refused or failed to respond after followups, even though the survey was experimental and reports were not mandatory. As shown by Table 8, the total "non-response"—including post office returns and unusable replies of all kinds—amounted to 8.0 percent of the gross sample.[7] This doubtless could be reduced considerably in a subse-

[6] A small survey was undertaken in 1953 to test the feasibility of collecting data on commodity "flows" by private and exempt for-hire trucks. Those data include tons and ton-miles by commodity, class of business, size of truck, etc. A report of that test is expected to be completed shortly. The Dominion Bureau of Statistics of Canada recently undertook a mail survey in Manitoba in which "logs" were used. Other surveys of this general sort are being or have been conducted in England, Switzerland, and some other European countries.

[7] The percents shown in Table 8 are based on expanded totals to provide estimates of the

Table 8

Percentage Distribution of Total Power-Units (Trucks and Truck-Tractors), by State, by Type of Response

Category	5 State total	State				
		Maine	Michigan	Missouri	Pennsylvania	Washington
(1) Purposely excluded from tabulations:						
a. Owned or leased by I.C.C. operators	4.3	1.5	5.9	2.9	5.1	2.5
b. Out-of-state	0.6	0.7	0.3	0.8	0.6	0.8
c. Government owned	1.7	4.2	...	...	3.8	...
d. License not in use 6/30/52	1.0	8.0	0.7	0.8	0.6	...
e. Not considered to be trucks	2.3	1.6	1.3	0.8	4.0	2.4
Total purposely excluded	9.9	16.0	8.2	5.3	14.1	5.7
(2) Excluded due to non-response:						
a. Post office returns	2.6	1.9	2.7	3.2	2.8	1.4
b. Not responding after follow-up	2.5	1.0	2.4	3.5	2.2	3.0
c. Refusals	0.2	0.1	0.8	0.1	...	...
d. Other	2.7	4.6	2.3	2.7	2.4	3.3
Total non-response	8.0	7.6	8.2	9.5	7.4	7.7
(3) Included in tabulations	82.1	76.4	83.6	85.2	78.5	86.6
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of vehicles indicated by license numbers found in state files (thousands)	1,134.9	64.8	263.3	225.0	423.5	151.6

quent survey by cutting the time lag between selecting the sample and querying owners, and by providing more explicit instructions for reporting in the event a transfer has occurred.

Almost 10 percent of the total vehicles traced by license numbers were found to be outside of the scope of the test, and were purposely omitted from the tabulations. In Michigan, Missouri and Washington all types of government trucks and truck-tractors could be recognized by their license numbers, and none were picked in the original sample. This procedure was followed for all other excluded classes, insofar as license numbers could be used for this purpose.

Consequently, the 9.9 percent represents essentially the balance that could not be identified by license number alone. The principal effect of having some out-of-scope vehicles in the original sample is merely to increase the work load to the extent of getting enough information to classify them with respect to scope. The net usable sample, after adjustment for non-response and out-of-scope cases, represented about 82 percent of the total license numbers in the original sample.

One other aspect of the rate of response is interesting and quite significant—the rate of response to individual questions on the form. In general, truck owners tend to skip questions that require judgment or "guessing" more frequently than those that can be answered by direct observation. About 99 percent of the usable returns had a check mark on one of the body type pictures or a description of the type of equipment owned. The one percent non-response was attributed mostly to a misinterpretation of instructions for reporting body type when the person owned a truck-tractor without a semi-trailer.

Many persons found the check boxes in the occupational questions (items 5–9 of the form) misleading or confusing, and went to considerable effort to describe their activities in the space reserved for comments. Yet, despite difficulty of interpretation, every respondent in two states and all but a small fraction of one percent in the other states answered these questions sufficiently well for coding to the significant occupational classes.

The response rates were distinctly lower in cases where the facts

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percent which would have fallen into each class if a complete enumeration with the same procedures had been attempted. An unexpanded distribution of sample cases would show essentially the same results.

OFFICE OF
THE DIRECTOR
Form TPN-1
(10-7-52)

DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
WASHINGTON 25

VEHICLE DESCRIPTION
Make Weight or Rated Cap. License No.

Gentlemen:

Information is needed with respect to motor trucks, their ownership and operation, as part of a Census of Transportation in 1953. Your answers to this form will assist in improving the questions to be asked in the Census and thereby will aid in simplifying reporting for truck owners.

Please answer the questions on this form with respect to the vehicle described above, which we understand is registered in your name.

However, if you were not the registered owner of the above vehicle some time between July 1, 1951 and June 30, 1952, or if that vehicle happens to be a fire engine, police patrol, ambulance, hearse, station wagon, taxicab or other vehicle primarily designed to carry passengers, please indicate that fact under "Remarks" in Question 20 and answer only Question 21

If you are a common or contract carrier operating under authority of a permit or certificate issued by the Interstate Commerce Commission, please answer only Questions 19 and 21.

Your report will be accorded the strict confidential treatment required by the provisions of the Census law. The report cannot be used for purposes of taxation, investigation or regulation, nor can it be seen by other than sworn Census agents.

It will be appreciated if you will complete and return this form within ten days. A return envelope which requires no postage is enclosed for your convenience. If you have any questions regarding this form, please address your inquiry to the District Office indicated on the return envelope.

Sincerely yours,

Roy V. Peel

Roy V. Peel
Director
Bureau of the Census

Enclosures

Coss-DC 37898

Budget Bureau No. 41-S218.1; Approval Expires December 31, 1952

CONFIDENTIAL - This report cannot be used for purposes of taxation, regulation, or investigation. Only sworn Census employees will see your statements.

Form TPN-1
(10-7-52)

U. S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
Washington 25, D.C.

SELECTED INFORMATION ON TRUCK OWNERSHIP AND OPERATION

GENERAL INSTRUCTIONS - If the vehicle described in the box on the front page of this form is a truck and you usually haul a trailer behind it, treat the truck and trailer as a combination and report for both vehicles as a single unit. If the vehicle is a truck-tractor, please report it in combination with the semi-trailer you usually hitch to it. If you customarily also haul a full trailer behind the tractor-semi-trailer combination, report the entire combination as a unit. Do not substitute information for any other truck or combination you may own or operate. If you do not have records, please give your best estimate. "You" refers to the person or business specified in the address box on page 1.

1. Body Type and Size - (Check body type of truck or semi-trailer usually hauled behind your truck-tractor, and give approximate length or capacity if requested in the box you check.)

☐ Pick-up or Express

☐ Panel or Sedan Delivery

☐ Multi-Stop (Step-in)

☐ Platform or Stake
Length of cargo-carrying space _____ feet

☐ Van-Non-Refrigerated
Length of cargo-carrying space _____ feet

☐ Van-Refrigerated
Length of cargo-carrying space _____ feet

☐ Dump
Capacity _____ cubic yds.

☐ Tank
Capacity _____ gallons

OTHER: (Specify, such as cement truck, specially equipped service truck, etc.)

_____

_____

_____

2. Number and arrangement of axles on the truck or combination. (Check one)

2 or 3 Axles

4 Axles

5 Axles

If more than 5 axles, describe:

Form TPN-1

Comm-DC 37690

3. What is the total number of tires on truck or combination (except spares). FOR EXAMPLE, a 2-axle truck may have 4 or 6 tires depending upon whether the rear wheels are single or dual, for similar reason, a 3-axle truck may have 6 or 10 tires, and a 3-axle combination may have 6, 8 or 10 tires.

Number of tires _____

4. What is the size of REAR tires? (Please give size and ply, such as 8.25 x 20 - 10 ply.)

	Size	Ply
Truck or truck-tractor.....	_____	____
Semi-trailer or trailer (if any).	_____	____

5. Please check your principal field of business or other gainful activities: ("Your" refers to the person or business specified in the address box on page 1.)

- ☐ Agriculture, forestry or fisheries
- ☐ Mining
- ☐ Contract construction
- ☐ Manufacturing
- ☐ Transportation
- ☐ Communication or other public utilities
- ☐ Wholesale trade
- ☐ Retail trade
- ☐ Finance, insurance and real estate
- ☐ Services (such as hotels, amusements, automobile repair services, etc.)
- ☐ Government (Federal, State and local)
- ☐ Other

6. Please describe more fully your principal activity within the field checked in Question 5 above. (EXAMPLES: (1) If "your" refers to a business, describe as "retail furniture store," "local trucking principally of household goods," "electrical products manufacturing plant." (2) If "your" refers to a person, describe as "proprietor of retail hardware store," "employee in accounting firm," "self-employed carpenter," etc.)

_____
_____
_____
_____
_____
_____

7. Did you get more than half of your gross income from trucking business (including leasing or rentals of trucks WITH DRIVERS)? NOTE: "You" and "your" refer to the person or firm represented in answers to questions 5 and 6.

- ☐ Yes
- ☐ No

If "Yes," what is the customary name and address of the head office used for the trucking operations?

Name _____

Street _____

City and State _____

8. Please check the box that most nearly describes the purpose for which the specified truck or combination was used most of the time:

- ☐ To haul for others for-hire, or lease (or rent) to others WITH DRIVER.
- ☐ To lease (or rent) to others WITHOUT DRIVER.
- ☐ To haul goods or carry men and material as a part of your principal business activities (except in for-hire trucking or leasing).
- ☐ For your own (or family) personal transportation.
- ☐ Other (describe briefly) _____

_____
_____
_____
_____
_____
_____
_____
_____

9. If you used this truck or combination mostly for hauling for-hire or for leasing (or renting) WITH DRIVER, please check the box that most nearly describes the principal type of operation.

- ☐ Lease with driver, usually for periods of less than 30 days.
- ☐ Lease with driver, usually for periods of more than 30 days.
- ☐ Hauling for others on own billing

10. What type of fuel is used by this truck or truck-tractor?

☐ Gasoline
☐ Diesel fuel
☐ Liquid Petroleum Gas

11. About how many miles per gallon of fuel do you get in this vehicle?

_____Miles per gallon

12. Approximately how many miles was the vehicle driven during the 12 months ending June 30, 1952; if you were the registered owner for only a part of that period, please report for period of your ownership; if records are not readily available, please estimate.

_____miles driven during_____months

13. About what proportion of the total miles reported in Question 12 were for trips that were longer than 25 miles in length (one way basis)?

☐ None
☐ Some, but less than 1/4
☐ Between 1/4 and 1/2
☐ Between 1/2 and 3/4
☐ More than 3/4

14. In what State and County was this vehicle garaged (or parked) most of the time?

State_____County_____

15. If the year model is not shown, or is incorrect, in the vehicle description box on the front page, what is the year model or year manufactured?

_____

16. Were you the registered owner of this vehicle on June 30, 1952?

☐ Yes
☐ No *(If "No," skip to Question 21)*

17. As of June 30, 1952, was this vehicle leased (with or without driver) to a for-hire carrier?

☐ Yes
☐ No

18. If leased on June 30, 1952 to a for-hire carrier, please give name and address of the carrier to whom it was leased:

Name_____

Address_____

19. As of June 30, 1952, was this vehicle owned by a common or contract carrier who has a certificate or permit issued by the Interstate Commerce Commission?

☐ Yes
☐ No *If "Yes" give the carrier's I.C.C. docket number*_____

20. Remarks

21. Information supplied by:

Name_____

Address_____

Date_____

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were not accurately known. For example, the questions concerning vehicle miles operated during the last 12 months and average miles per gallon were left blank for 5 to 10 percent of the vehicles in each state. The question with respect to the proportion of vehicle miles in trips of 25 miles or more was much more complex, but the rate of response was only moderately lower than for the simpler estimates.

The format also had an effect on the response to specific questions. A substantial part of the total failed to state body length or capacity when required in question 1 and axle arrangements in question 2. The diagrams and check boxes doubtless diverted attention away from those items; although they were very useful for obtaining reliable and almost complete response on body type.

Response Errors

In addition to sampling variation and other limitations mentioned above, the results are subject to errors of response. There has been no opportunity to conduct follow-up field studies to determine the extent of these biases. However, a few observations, mostly of a general nature, can be made.

Since the year-model information was taken directly from registration records, and is easily reported, there should be very little response error on that item. Body type, number of tires, and tire size are generally well known by the truck owners and probably were reported correctly in nearly all cases.

The questions concerning occupational use were unsatisfactory in some respects, and should be revised and retested before a full-scale survey is undertaken. Although the results are reasonably consistent with fragmentary information available from other sources, considerable difficulty was encountered in placing borderline cases in one of the three major classes of use—private, "exempt" for-hire and lease, and incidental.

Most truck owners do not keep detailed records on the operation of each truck. Therefore, the figures given on miles per gallon, annual mileage, and length of haul represent estimates or opinions in most cases. No direct measurement of the extent of response-error is available, but the distributions are fairly stable from state to state, and seem to conform with what might generally be expected on the basis of a priori considerations. Some experts believe, however, that the average respondent tends to overstate the true miles per gallon.

Conclusions

The general method may be adapted to a wide variety of situations. Since information is collected on a sample basis, rather than by a complete enumeration, it is readily possible to design a project to collect specified data at minimum cost for whatever reliability is deemed necessary—or to collect the best data that can be obtained within the limits of available funds.

Such projects can be adapted readily to whatever geographic areas are needed. This is especially true for tabulations for states or larger areas, but representative samples can also be drawn—usually with somewhat more trouble—for smaller areas. However, it should be recognized that samples may not be less expensive than complete enumerations for collecting reliable data for very small geographic areas.

Furthermore, under emergency conditions, a detailed inventory of motor vehicles may be needed to assist in directing a rapid mobilization of specific trucks in distress areas. In that event, a complete enumeration would be essential. However, under normal conditions, the principal need for statistics appears to be at the state level, and can be satisfied effectively by sampling procedures.

The questions asked on the test survey were restricted to a limited number that could be answered readily by most truck owners without reference to records. A much wider range of questions doubtless could have been asked. And, by modifying the collection procedures, it probably would be feasible to obtain more reliable data on annual vehicle mileage and average miles per gallon of gasoline; to collect useful statistics on such matters as the volume of traffic (tons carried and ton-miles) by class of commodity; and perhaps even to obtain statistics on maintenance and operating costs and other facts concerning trucks and truck operations.

Those applications should be characterized as "promising" because specific tests have been undertaken on only two phases—the one reported in this article, and another on commodity movements by trucks on hauls for distances of twenty-five miles or more. Much remains to be done to improve the techniques, determine reliability of results, and learn the range of useful information that may be obtained by these procedures.

THE ENO FOUNDATION FOR HIGHWAY TRAFFIC CONTROL

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